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ALTERNATING CURRENT ACCUMULATOR TRACTION.

In the Digest this week appears an account of a novel system of traction which is shortly to be tried in Germany. Its essential features are the use of two motors, one for alternating or polyphase currents, and the other for direct currents, on each car, the direct current being applied by a battery of accumulators carried on the car, and the two motors being in mechanical connection. Alternating or polyphase currents at a convenient voltage are fed to the trolley line, which is omitted at stations, switches, crossings, etc. The accumulators are charged when the car is being operated by the alternating motor, the direct-current motor then acting as a dynamo. It is stated that the controlling mechanism is simple, and that experimental trials demonstrate the value of the system.

At the first glance this system seems open to a number of very serious objections, its complexity, high first cost, inefficiency due to the various transformations of energy involved, and the great weight of the two motors and the accumulators being apparently insuperable objections to its use. On closer inspection, however, it is evident that much is gained by the increase in weight and cost, for the system combines the great advantages of alternating currents for long-distance transmission with the storage power of accumulators.

It is certain that we must look to the alternating current for the solution of long-distance electric railway problems. The requirements of high speed and heavy electric traction are such that an increase in the weight of the locomotive motor, when one is used, is not detrimental within certain limits. The efficiency of accumulators under continuous charge and discharge at a point near their maximum capacity is high, while that of a synchronous or polyphase motor is also very great. By combining the efficiency of long-distance power transmission by alternating currents with the ease of starting and control possessed by direct-current motors, a system of great flexibility and availability has been produced.

It seems, however, that the gain in simplicity of the trolley system made by the method outlined above is more than counterbalanced by the difficulties attending the transportation of the accumulators and the alternating-current motors. The effective value of the proposed method would be equally as great were the line fed by rotary transformers, the cars supplied with direct-current motors only, and the accumulators conveniently grouped in sub-stations.

WIRELESS TELEGRAPHY.

The press, particularly the more sensational portion of it, has been teeming for some time past with accounts of recent alleged marvelous inventions for telegraphy without wires. The question naturally arises of what benefit this variety of signaling would be if it were perfected along the lines indicated.

The efforts of the experimenters who have attacked the problem have been directed to the making of a sensitive receiver which will respond to the action of Hertzian waves. These receiving mechanisms require to be "tuned" into synchronism with the source of oscillations, but will respond if tuned to the octave or in some other

simple harmonic relation with the generator. Under these circumstances two difficulties in the practical operation of such systems are immediately apparent. One is that the receiving and sending mechanisms must be kept in constant synchronism with one another, the slightest change in the capacity or inductance of the circuits of either being sufficient to upset the delicate balance necessary. The other and even more serious difficulty is that the signals sent out may actuate a number of receiving instruments without the knowledge of the sender, and that, on this account, the privacy of the messages transmitted may be invaded.

In war, for example, signals sent out by this means could be picked up by an enemy provided with an adjustable receiving instrument. So far as military utility is concerned the Hertz-wave telegraph has but one point of superiority over the heliograph, which is its ability to work in fog or rain. This consideration apart, it appears to be no more available than the system of flag or "wig-wag" signals now in use, while the weight and delicacy of the mechanism employed at the sending end are serious disadvantages.

What possibilities may develop themselves in this field can only be left to conjecture and the unfolding of the future, but it seems reasonable to predict that the systems recently and widely discussed will be found to have more interest than utility. In a system of telegraphy, speed, simplicity, and solidity of the apparatus employed must be united with secrecy and certainty. These requisites are indispensable for either civil or military uses.

ELECTRICAL ENGINEERS IN THE ARMY.

In another column is an interesting letter from Major Edward B. Ives, of the New York National Guard, concerning the recent formation in England of a volunteer corps of electrical engineers. At the time of our recent comment upon this subject we were not informed that a corps of this character existed in this country, or that the matter had been discussed with reference to the formation of one.

The services of a trained body of expert electrical engineers in time of war would be invaluable. Modern warfare has grown to be a thing of exact and scientific calculation. New methods have been introduced, many of them electrical, and the methods of signaling, of firing explosives at a distance, of illuminating works or bodies of land or water over which the enemy might be expected to approach, are all electrical. The possibilities of further utilization of electrical means for purposes of defense and offense are very great, and there is no doubt that the maintenance of such a corps as was suggested in these columns recently would be of the utmost use.

This seems to be a subject which is most appropriate for the consideration of the American Institute of Electrical Engineers. It would be an easy matter to obtain the requisite number of volunteers, all of them picked men in their respective lines of engineering. In just what way this corps could be utilized at present in the army or on what footing it would stand, it is not at present necessary to discuss. The fact remains, however, that in case of war the services of such a body would be of the most enormous importance, and that in times of peace the results to be expected from thus directing the attention of these engineers to military and naval problems would be a great enlargement of the means at the disposal of the army and navy in their respective departments.

The one complication that might arise and cause trouble in the formation of this corps would be the status of its officers and men with reference to each other. It is easily conceivable that in the corps and in civil life the officers and men might not occupy the same respective situations. It seems, however, that this difficulty might easily be obviated by the enrollment of electrical artisans as the rank and file, and of electrical engineers, members of the American Institute, as the officers. It is not impossible that, with the assistance of the War and Navy Departments, these volunteer corps could be started in various parts of the country and trained to a state of high efficiency in a short time. It is most earnestly to be hoped that the matter will receive the attention of the American Institute of Electrical Engineers.

ELECTRIC LIGHTING IN RUSSIA.

Progress in electric lighting in Russia has an extremely hard road to travel, as is evidenced by M. Lutoslawski in a communication published in this issue, on the subject of lighting systems in Russia.

The American idea of Russians in general is that they are a people far behind the times in every line of progress. If this is true in the smaller things and conveniences of life, it could hardly be expected that they should find life burdensome without electric light.

M. Lutoslawski, however, presents a state of affairs with respect to electric lighting in the more modern and progressive communities in that country that is amazing. The proverbial rascality among the official classes is one of the greatest obstacles to progress in Russia, and evidences of its pernicious influences are manifest when any efforts are made to improve existing conditions.

Money appropriated for the extension of lighting in Russian towns, it appears, is not all expended for legitimate purposes, and more or less of it goes into the pockets of underpaid and dishonest officials. In the midst of the discouragements that have hitherto beset the progressively inclined, there is evidence of an awakening in various Russian cities with regard to the improvement of street lighting. This sentiment, unless further smothered by official rottenness, will undoubtedly grow and extend, and the time may not be very remote when electrical enterprise will find more favorable conditions for development on Russian soil.

What little electric lighting there is in Russian towns is supposed to be conducted on the moonlight schedule, but if some high government official is expected to make a visit, a favorable impression is made upon him by a close adherence to the schedule, which, ordinarily, is liable to suffer through indifference or neglect. Thus the progressive spirit of the local officials receives a temporary veneer, and their tenure of office is thereby strengthened. This state of affairs, however, could not exist in more enlightened communities, and it is inconceivable that it can much longer prevail, even in darker Russia.

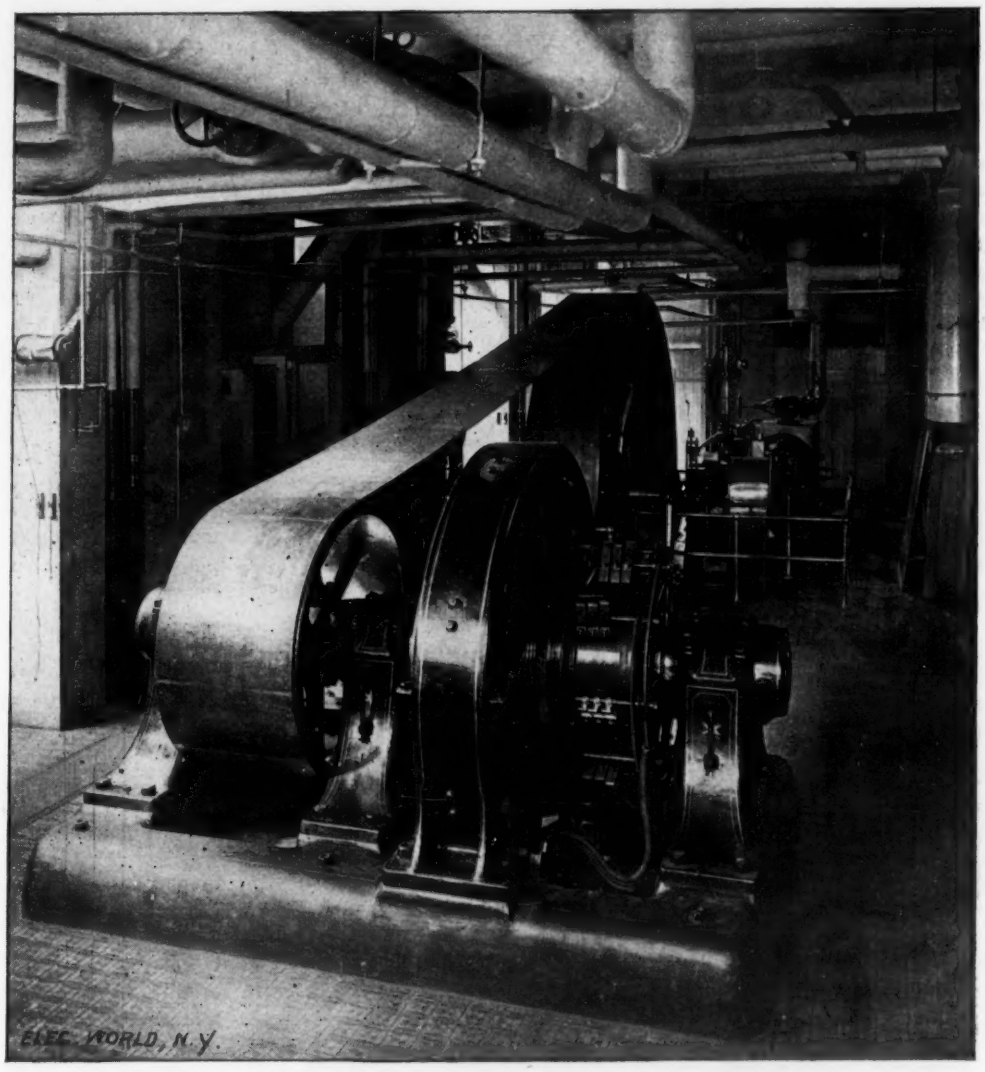
The baneful effect of municipal control of public lighting, which principle is a cherished delusion among a few misguided enthusiasts in our own country, is strikingly exemplified in the most aggravated form in the Russian practice.

Exhibition of Street Railway Apparatus in Hamburg.

The Street Railway Company of Hamburg, Germany, proposes to hold an exhibition of street railway apparatus during August next, the dates set for the affair being from the 5th to the 9th, both inclusive. The exhibits will include motor cars, trucks, axles, wheels, motors, controllers, lamps, overhead trolley parts and equipments, measuring instruments, rails, switches, crossings, etc. Drawings and models will also form a feature of the exhibition, which will be held at the Falkenreid depot of the company.

The Power and Lighting Plant of the New York Life Building.

THERE can be no question as to the perfection of the modern office palace. Attaining their highest development only within the past decade, such standing monuments of wealth and mechanical skill have almost become commonplace in our large cities, and certainly embody all features, mechanical and otherwise, which in any way tend toward further comfort, economy and elegance. New York has been particularly fortunate in this direction, and can point to a larger array of modern business structures, for both office and other purposes, than any other metropolis, the majority of which excel in height and in artistic architectural effects. While apparently the aim in most instances has been to reach skyward to the maximum extent, yet there have been many cases where the owners and builders have been less desirous of crowding the profitable floor space by a freak-like sky-scraping extension, for, having at their disposal ample ground area, they have rather directed their efforts to the perfection of the building as an example of architectural and mechanical excellence. New York's latest structure of this type is the recently completed New York Life Building, located on lower Broadway, and occupying an entire block, bounded by Broadway and Elm Street, front and rear, and Leonard Street and Catharine Lane on the north and south sides. This building may certainly be called a palace in every way. It is located in the midst of the New York dry-goods district, fairly teeming with wealth, and probably has cost more and embodies more artistic and modern mechanical features than any similar structure of its kind.



ONE OF THE BELTED GENERATORS.

The old building formerly occupied by the company was located upon the same plot, but only extended back one half of the block. Several years ago the new building was started by the erection of the east half, which reached from the rear end of the old building to Elm Street. The completion of this structure saw the removal of the offices of the company, the tearing down of the old building, and the erection on the other half of the plot of the remainder of the present building. The new structure has a frontage on Broadway of 60 feet, and extends backward about 395 feet to Elm Street, at which end it is about 85 feet wide. It has thirteen stories on Elm Street, and a basement which is used for machinery and storage. The height of the building is 184 feet. The construction is of steel girder and pillar type, erected upon a foundation of grillage beams and piling. The Broadway, Elm and Leonard Street walls are of marble, and are built so that they are self-supporting. There are 325,000 square feet of floor space available, of which 88,000 are occupied by the insurance company and 141,000, distributed into 335 offices, are for rental.

It is but fitting that a structure of such grandeur should be properly equipped with a machinery plant commensurate in excellence with the building itself. Unquestionably this has been accomplished, for it may well be said that the machinery and electrical equipment of this building are well worthy of marked attention., and while embodying perhaps no strikingly novel features, it must be considered as a most excellent example of solidity and massive construction, where wealth has been unstinted and the principal aim has been to insure continuous operation with the smallest depreciation and difficulties. The entire machinery department occupies the basement of what may be called the east half of the building, although a small part of the west half is also used for this purpose. This arrangement gives the power plant a ground area of approximately 60 by 200 feet, an allowance which is most striking, particularly when considered in comparison with the generally cramped arrangement of the machinery in other modern structures of a similar nature. The coal used in this power plant, the arrangement of which may be seen from the accompanying plant, is brought in on Catharine Lane and dumped into coal bunkers on that side of the building, about midway between Broadway and Elm Street. From this bunker a narrow gauge track extends to the front of the boilers, and coal is brought to this point on small cars.

The power plant consists of four double-drum horizontal-tubular Babcock & Wilcox boilers, each of 350 horse-power, and arranged in two batteries of two each. These boilers are set in brick side and bridge walls, with white enameled brick exteriors. The fronts are of nicely finished cast iron, and each boiler furnace is reached through three doors. The arrangements of gauges, blow-offs, etc., is ornamental and mechanically noteworthy, and all fittings and pipes about the boilers are of polished brass. Each boiler has 144 4-inch tubes, and the water and steam drums measure 24 feet in length by 42 inches in diameter.

From each boiler an 8-inch valved pipe is connected to a 12-inch main steam line, so arranged, that any one of the boilers or all of

them can be used for supplying steam. One end of this steam main, which passes along the upper part of the boiler room in front of the boilers, extends to the pump room and the other end to the engine room. The feed water for the boilers is taken from the Croton supply mains through three Worthington pumps, 9-inch (water) by 5 by 10 inch (steam) cylinders. These pumps are so arranged that any one or all may be used, feeding into a single boiler supply main passing to a Berryman feed-water heater in the pump room, of 600 horse-power capacity. After the water has been heated here to over 200° Fahr. it passes on to a Ward purifier and filter, from which a double pipe extends along the front of the boilers, each of which is tapped thereto through a brass pipe and fittings. In addition to this pump supply each boiler is fitted with an injector, two of which are placed on each side wall of each of the two batteries. The injectors also take water from the city supply mains, and are arranged so that they may be operated in battery to supply all boilers or any one boiler, or so that any injector may be used for any boiler. Each injector is steam piped from the main steam line previously mentioned. It is interesting to note that, including the boiler feed pumps, there are twenty-one separate pumping machines which find use in this plant. All are of the Worthington type and manufacture, and range from the small "baby" for pumping drippings to a 14,000-gallon high economy pump for elevator service.

The generating plant consists of four units. Three of these are Watts-Campbell simple non-condensing Corliss engines, directly belted to three large General Electric generators, while the fourth unit consists of a direct-connected General Electric generator and Ideal engine. The belted units are respectively of 125, 225, and 250-hp capacity, and are belted to generators of 75, 125, and 175-kw capacity, which operate at 270 and 275 r. p. m. The belts are particularly massive, being 16, 24, and 31 inches wide, and of carefully prepared two-ply leather. The direct-connected Ideal engine, which is the smallest unit, only used after shut-down and at night, is of 40 horse-power, while the dynamo is of 25-kw capacity. A notable feature about the belted dynamos is the extremely massive pulley construction. Each engine is set on a foundation of brick on a concrete footing, the brick being 6 feet deep below the bed-plate of each engine.

The three largest dynamos have triple bearings, the end of the armature shaft being carried in bearings on each side of the pulley. The two larger machines are of the eight-pole type, while the two smaller are six-pole machines. They are all compound-wound for 5 per cent. drop. It may well be said that the largest unit of this plant is probably the largest used in any isolated plant today. Extending from each dynamo are the leads to the switchboard, which are run in iron-armored conduit beneath the floor to the board. This is particularly elegant in design and construction,

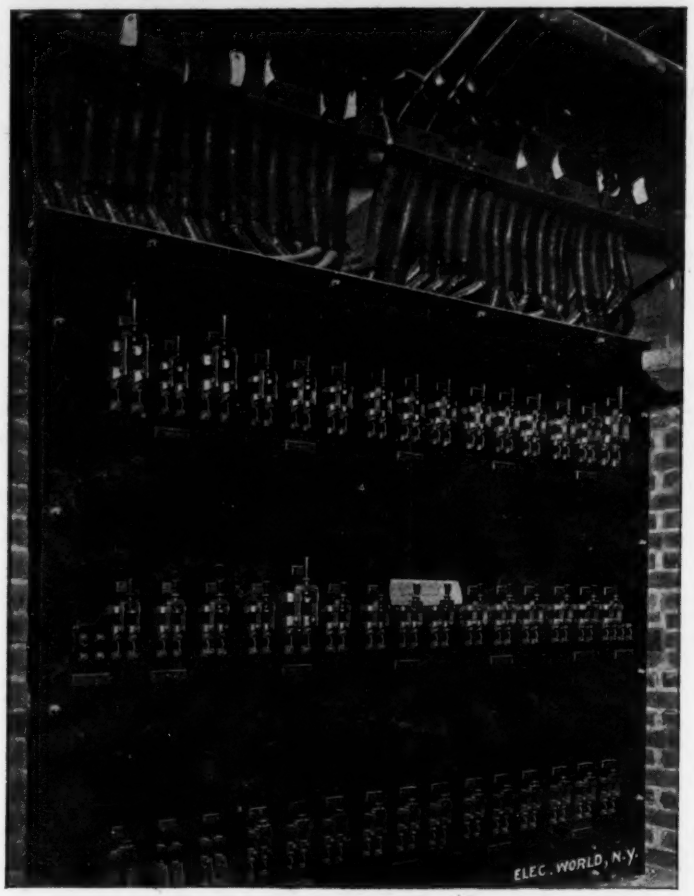
The Back of the Switchboard.

and consists of three very large marble panels set side by side in ornamental iron-work framing, and inclosed at the rear with a grilled wire work with several doors. In width from end to end it is about 24 feet, and extends upward about 12 feet. The centre panel is used for dynamo control, and the leads from the machines are brought to triple-pole switches mounted on this panel, the central blade of each switch being used for equalizer purposes. These switches connect the dynamo leads to a common bus, which extends at each end across to the distributing feeder panels on each side of the central dynamo panel. Each dynamo lead is also equipped with a Westinghouse circuit breaker and separate Weston ammeter. Carpenter enamel rheostats are used to control the fields of the dynamos, and are also mounted on this panel, which, in addition to the above apparatus, is equipped with a differential galvanometer for testing and ground-detecting purposes, and a differential Weston voltmeter and suitable switch for comparing the voltage of any machine which is being put into service with the bus bars before throwing the switch. A common voltmeter connected to the bus bars is also provided on the feeder panel to the right, and a total output ammeter is provided at the top of the feeder panel to the left.

The Switchboard.

All circuits feeding the east half of the building are taken direct from the right panel, which is equipped with thirty-two double-pole fused knife-blade switches. Six of these circuits are equipped with Westinghouse circuit breakers, each placed at the bottom of the board. These circuits extend direct to the panel boxes. The left panel supplies the west half of the building. On this panel are

mounted eighteen double-pole fused knife-blade circuit switches and the same number of Westinghouse circuit breakers. A corresponding number of feeders extends from these switching appliances to a large distributing panel in the basement of the west half of the



A PANEL BOARD.

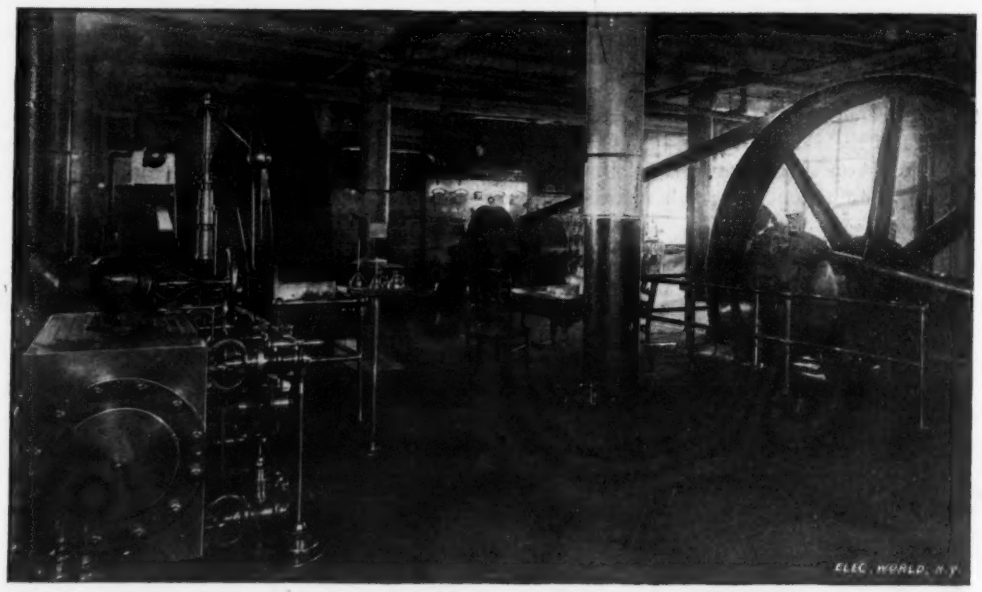
building, from which point feeders are re-distributed through various mains and controlled by fused double-pole knife-blade switches, to the various panel boxes on the different floors. There are approximately seventy-five distributing panels used throughout the building, each of which has approximately twenty branch circuits. All panel boxes in the west half of the building are equipped with Newton detachable-switch fuse holders. The branch circuits from the panel boxes to the outlet are also run in iron-armored interior conduit and are at each outlet terminated in an iron outlet box. Similar boxes are also used for switch receptacles, which are mostly of the Cutter double-push flush type. Approximately there are between 8000 and 9000 16-cp incandescent lamps used throughout the building. All branch circuits are white-core Grimshaw duplex wire, run in single tubes, while the mains and feeders are run singly in each tube. Grimshaw wires and cables are also used for mains and feeders.

An inter-communicating telephone system connecting the various company offices which occupy the first seven floors of the east half of the building is used, terminating in a 100-drop switchboard in the basement. There are at present forty telephone sets connected with this board, and it is almost astonishing to watch the number of calls coming into this small central station. One operator is kept busy from 9 A. M. to 6 P. M., with scarcely any stops. The switchboard was manufactured by the Western Telephone Construction Company, and installed, as well as the entire system, by the Wilson-Bates Electric Company. Ericsson receivers and transmitters are used throughout, both mounted on a single handle. All the telephone wires for this system, as well as those for bells and other signals, are run through iron pipe. There are over 500 call bells used for company purposes alone, the current for these being supplied by a Crocker-Wheeler motor-dynamo, located in the engine room. Aside from this signal piping, the entire building is equipped with a system of signal wire iron pipe raceways, extending from floor to floor, at each of which a panel distributing board is located. These are usually in the main halls.

Centrally located in the form of a half circle are the passenger elevators, there being twelve public passenger cars running the entire height of the buiding. Adjacent to the public passenger cars are two freight elevator cars, and in addition to these there is a private elevator extending down from the president's room on the second floor. Three sidewalk hoists also form part of the elevator equipment. All this elevator machinery is of the hydraulic type, and was furnished by Messrs. Otis Brothers & Co. The elevator pistons work at a pressure of about 160 pounds, and the public elevator cars run at a speed of about 300 feet per minute, each having a capacity of about 2500 pounds. The shaftway doors are opened automatically by means of a compressed air system arranged so that whenever a car stops at any particular landing the door automatically opens and closes again after the car has left that landing. For this hydraulic elevator service there are three immense compound pumps in the basement and one high-pressure pump, which is used for safe lifting in conjunction with one of the freight elevator cars. Extending to the seventh floor is an electric book hoist with automatic push-button control. This hoist was installed by Otis Brothers & Co., and operates similarly to the arrangement shown in a previous number of THE ELECTRICAL WORLD.

At each floor for elevator signaling there is located a double push-button, which, by means of a suitable intercommunicating system of wires, signals to any of the elevator cars which may be moving in the direction corresponding to the button pushed. This system was installed by Benner & Opdyke, and is exceedingly ingenious. There is a double-button contact device located at each landing. One button is marked "up" and the other "down."

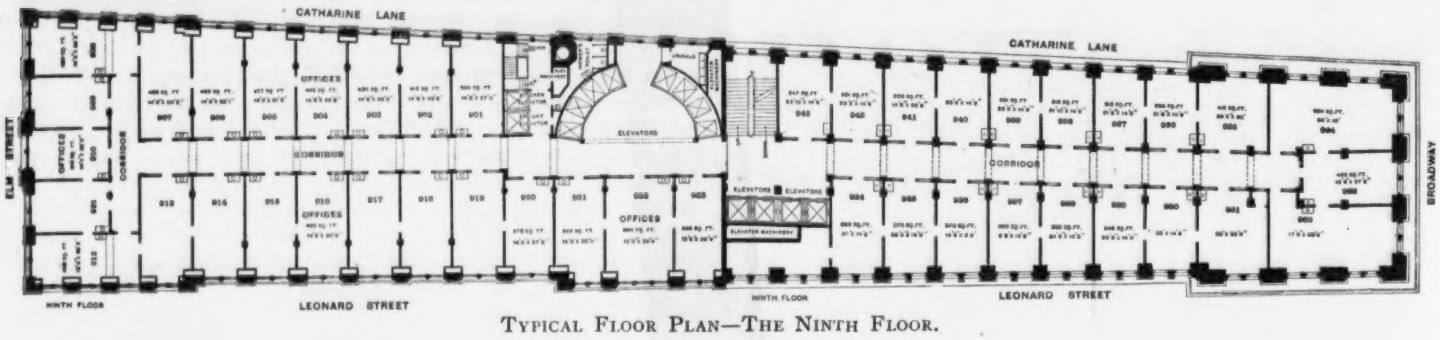
A novel departure has been made in the ventilating system for supplying warm air and air at ordinary temperatures throughout the building. All air for this purpose is first filtered through a zig-zag wall of cheese-cloth filters located in the basement, and which will readily be seen from the plan. Three Sturtevant blowers are used, each operated by a separate throttle-governed Sturtevant engine. These fan blowers suck the air through the filter walls and thus insure a dustless air circulation. In front of each fan there is also a set of steam tempering coils for heating the air



VIEW IN THE ENGINE AND DYNAMO ROOM.

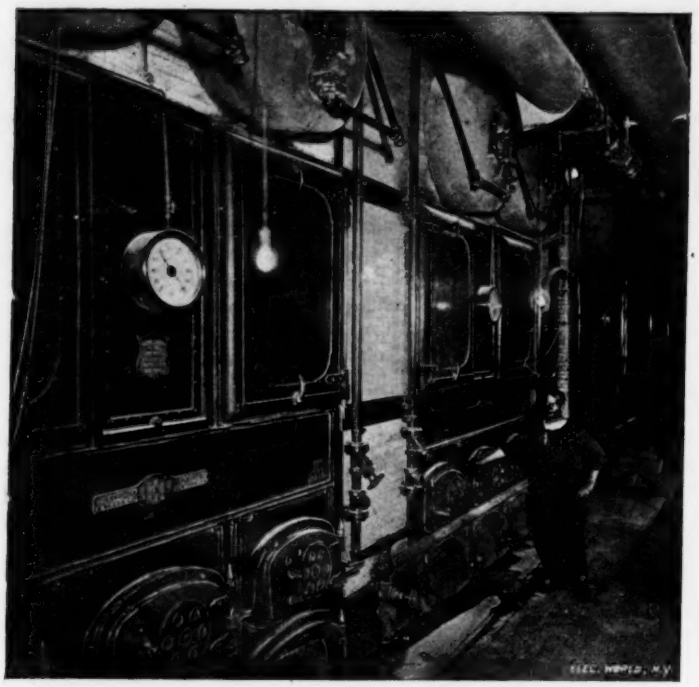
when necessary. The air from each blower passes up through the building through a large flue or duct, and at the top of each of these flues is an electric exhaust fan equipment operated by a C & C 5-hp direct-connected motor. These electrical equipments act as auxiliaries to the steam ventilating equipment in the basement.

For heating the building exhaust steam is used, in a very large number of direct-steam radiators. The exhaust from the engines and pumps is properly piped to the heating main, from which are tapped thirty risers extending to the various radiators throughout the building. The exhaust may also pass off into the air, and it is therefore equipped with a Keily back-pressure valve. The heating main may also be supplied with live steam from the main steam line in front of the boilers, running parallel thereto, and to which it is connected by a Keily differential valve and bypass. The temperature of the various rooms is automatically controlled by means of the Johnson thermostatic regulating system, which operates by means of compressed air, each thermostat consisting of a metallic strap actuating, when affected by temperature changes, a small air pilot valve, which in turn affects the compressed air steam valve on the radiator.

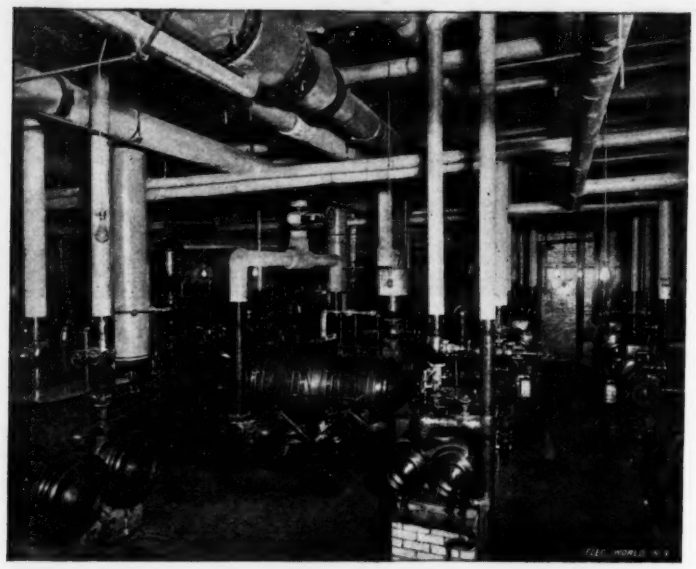


Typical Floor Plan—The Ninth Floor.

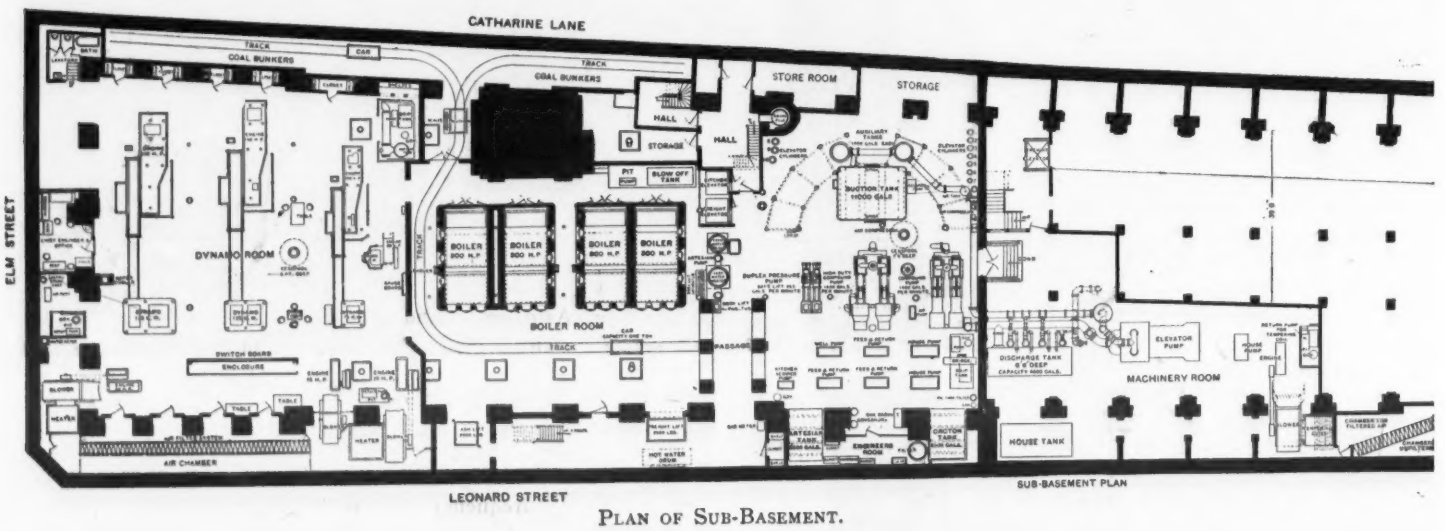
It is interesting to note that for the satisfactory operation of this plant, the engineering staff consists of no less than fifteen employees, under the supervision of Capt. Thos. Miller, who is in charge of the company's engineering department, and has been most prominent in the development of the present installation. The architects of the building were Messrs. McKim, Mead & White. The steam plant was installed by Messrs. Baker, Smith & Co. The New York Electrical Equipment Company and the Tucker Electrical Construction Company were the electrical contractors for the equipment of the east and west half of the building, respectively. Mr. C. O. Mailloux was the consulting electrical engineer on the entire plant, and Mr. A. R. Wolff was the heating and ventilating expert.



The Boilers.



The Pumping Plant.



Plan of Sub-Basement.

On the Theory of Electric Oscillations in Mutually Inductive Circuits.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

When a condenser of capacity C farads discharge through an inductance of L henrys, it is well known that the nature of the discharge depends upon the resistance R ohms of the discharging circuit. If the resistance, R, be relatively very large, so that the electric time-constant of the circuit, $C\ R$ seconds, is more than four times the magnetic time-constant of the circuit, L/R seconds, the discharge is aperiodic, and the charge in the condenser is dissipated without oscillation. If, on the contrary, the circuit's resistance, R, is so far reduced that the electric time-constant is less than four times the magnetic time-constant, the discharge is periodic, and the charge in the condenser is dissipated with oscillations. The frequency of the oscillations is

$$n = \frac{\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}}{2\pi} \text{ cycles per second.}$$

In the ideal case, when the circuit has no resistance, or $R = o$, the frequency of oscillation is increased to

$$n = \frac{1}{2\pi\sqrt{LC}} \text{ cycles per second,}$$

and in the absence of hysteresis the oscillatory discharge continues for ever. In such a circuit, the total reactance is zero, and therefore the total impedance is zero. In other words, the frequency of oscillation so adjusts itself that $L\Omega = \frac{I}{C\Omega}$ where Ω is the angular velocity, or $2\pi n$.

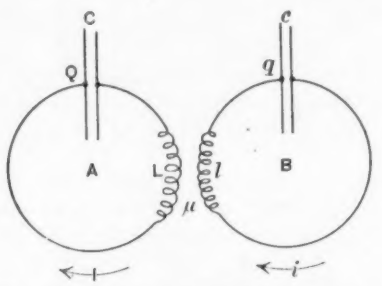


FIG. 1.—DIAGRAM REPRESENTING TWO MUTUALLY INDUCTIVE RESISTANCELESS OSCILLATORS.

Suppose that there are two of these ideal resistanceless oscillators, as represented in Fig. 1. A is a circuit containing a capacity, C, in series with an inductance, L; while B is a similar circuit containing a capacity, c, in series with an inductance, L. If these two circuits be sufficiently remote from each other that their mutual inductance $\mu = O$ henrys, then each vibrates independently. If charges $Q =$ and q be delivered to the respective condensers these charges will oscillate at the respective frequencies of $N = \frac{1}{2\pi\sqrt{LC}}$ and $n = \frac{1}{2\pi\sqrt{lc}}$ cycles per second.

But suppose that the two oscillating systems are suddenly brought into inductive relation, so that while leaving L and l unchanged, μ has a definite constant value, what will happen? It may be urged by the practically minded that since the conditions are ideal, that circuits always have resistance and condensers hysteresis, it does not matter what might happen in a case where these limitations are banished. But in spite of this objection, the answer has some interest, partly because, even in practice, it would only require slight modification to meet the actual conditions of resistance and dissipation, and partly because it is possible that molecular motions may be electromagnetic and of the oscillatory type, in which case their mutual induction might be important. Finally, even if it were granted that the question has no practical importance, it has, nevertheless, considerable theoretical importance.

The question has been considered in a brief but masterly manner by J. J. Thomson in his "Recent Researches in Electricity and Magnetism," 1893, p. 532, section 432, but the information obtained from the results there given is very meagre and in some ways misleading. We are not aware that the answer to the question has yet been published, and we, therefore, offer it.

As soon as the oscillators are brought into mutual inductive relationship, each oscillator will, in general, be traversed by two simple periodic currents of different frequencies. Thus, if N be the frequency of circuit A, and n that of B, $\mu = o$, then when μ is no longer zero, A will have two sets of oscillations; one N^1, of frequency higher than N, and one n_1 of frequency lower than n. The same will be true with respect to circuit B. It will have two sets of oscillations, one of frequency N^1 and the other of frequency n_1, but the amplitudes of these frequencies will, in general, be different in the two circuits. Particular cases may occur, however, where one of these two frequencies is absent from both oscillators. That is to say, it is possible to so adjust the charges for given circuits, or the constants of the circuits for different charges that the oscillations either of frequency N^1 or of frequency n_1 have zero amplitude; *i. e.*, are absent from both A and B. Such cases are exceptions, and when both frequencies are developed in one oscillator, say A, they must necessarily be also developed in the other oscillator, B.

As the inductive relation between the circuits is improved; *i. e.*, as μ is increased, N^1 increases and n_1 diminishes, until when $\mu^2 = L\,l$, the ideal case of complete mutual induction with no magnetic leakage in self-induction N^1 becomes infinite, while n_1 descends to a finite limiting value. It is, therefore, theoretically possible to increase the frequency of an oscillator indefinitely by linking its inductance sufficiently perfectly with that of another oscillator, but the practical range of success in this direction is probably limited, and it would obviously be more effectual to increase the frequency of an oscillator by reducing the inductance in its circuit, than by linking the inductance with a secondary oscillator circuit.

Viewed from a slightly different standpoint, one oscillator circuit, say A, when linked inductively with another, B, has no longer one frequency, at which its total reactance is zero. It has two frequencies, at which its virtual reactance is zero. These two frequencies are the same as those for which the total virtual reactance of circuit B, considered as the primary, is zero.

If we assume that the two circuits A and B, of Fig. 1, have imparted to them condenser charges of Q and q, coulombs respectively at a given instant $t = o$, and that the system is then released, the subsequent motion of the circuits is expressed by the equations:

$$q = B\cos\sqrt{\alpha}\,t + E\cos\sqrt{\beta}\,t \qquad (1)$$

$$q = b\cos\sqrt{\alpha}\,t + e\cos\sqrt{\beta}\,t \qquad (2)$$

Where $\sqrt{\alpha}$ and $\sqrt{\beta}$ are the two angular velocities of the doubly oscillating system (2π times the respective frequencies), the constants have the following values:

$$B = \frac{Q}{2} - \frac{\frac{Q}{2}(CL - cl) + qC\mu}{\sqrt{m}}\ ;\ b = \frac{q}{2} - \frac{\frac{q}{2}(cl - CL + Qc\mu}{\sqrt{m}} \qquad (3)$$

$$E = \frac{Q}{2} + \frac{\frac{Q}{2}(CL + cl) + qC\mu}{\sqrt{m}}\ ;\ e = \frac{q}{2} + \frac{\frac{q}{2}(cl + CL) + Qc\mu}{\sqrt{m}} \qquad (4)$$

$$\alpha = \frac{CL + cl + \sqrt{m}}{2C_c(Ll - \mu^2)} \qquad (5)$$

$$\beta = \frac{CL + cl - \sqrt{m}}{2C_c(Ll - \mu^2)} \qquad (6)$$

$$m = C^2L^2 + c^2l^2 - 2CLcl + 4C_c\mu^2 \qquad (7)$$

As an example, we may consider the following case:

$C = 4$ microfarads $= 4 \times 10^{-6}$ $\quad L = 0.25$ henry

$c = 1$ microfarad $= 1 \times 10^{-6}$ $\quad l = 0.25$ henry

Then the natural independent oscillation frequencies when $\mu = 0$ are $\frac{1}{2\pi}\frac{1}{\sqrt{CL}} = 159.1$, and $\frac{1}{2\pi}\frac{1}{\sqrt{cl}} = 318.2$ cycles per second respectively. As μ is increased up to the full possible limit of 0.25 henry, these frequencies are altered as shown in Fig. 2, and both frequencies are found in each oscillator circuit, according to equations (1) and (2). It will be seen that as μ approaches the theoretical limit, 0.25 henry, *i. e.*, when all the magnetic flux linked with the current of one circuit is also linked with the current of the other circuit, the higher frequency becomes indefinitely great, while the lower frequency tends to the limit 142.3 cycles per second.

If we suppose that C is originally charged at 1000 volts pressure

while c is originally without charge, so that, at time, $t = 0$ $Q = 4 \times 10^{-3}$ coulombs and $q = 0$, the equations (1) and (2) become:

With $\mu = O$ $Q =$ $4 \times 10^{-3} \cos 1000\, t$
and $q =$ 0

With $\mu = 0.1$ $Q = 0.235 \times 10^{-3} \cos 2236\, t + 3.765 \times 10^{-3} \cos 975.7\, t$
and $q = -1.883 \times 10^{-3} \cos 2236\, t + 1.883 \times 10^{-3} \cos 975.7\, t$

With $\mu = 0.2$ $Q = 0.631 \times 10^{-3} \cos 3610\, t + 3.369 \times 10^{-3} \cos 924.7\, t$
and $q = -1.46 \times 10^{-3} \cos 3610\, t + 1.46 \times 10^{-3} \cos 924.7\, t$

With $\mu = 0.24$ $Q = 0.769 \times 10^{-3} \cos 7936\, t + 3.231 \times 10^{-3} \cos 900\, t$
and $q = -1.322 \times 10^{-3} \cos 7936\, t + 1.322 \times 10^{-3} \cos 900\, t$

It will be seen that as the mutual inductance increases, the A charge is diverted more and more from the lower to the increasing higher

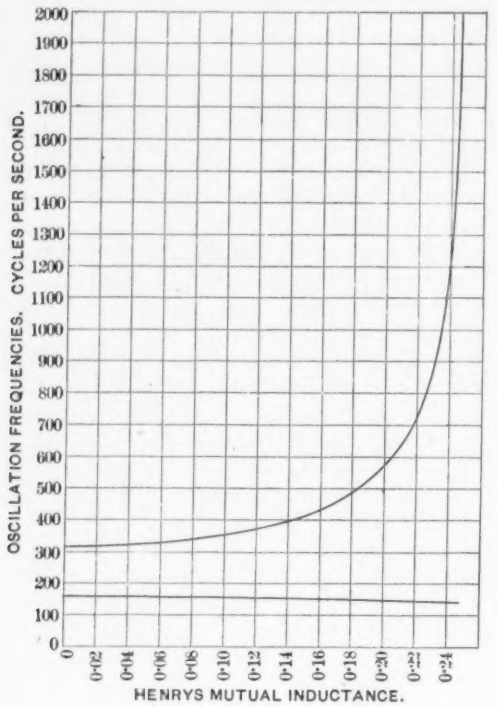


Fig 2.—Curves Showing the Influence of Mutual Induction Upon the Frequencies of Electrical Oscillators in a Particular Case.

frequency. In the B circuit the charge and energy are equally divided between the upper and lower frequencies.

When the two oscillator circuits are similar, *i. e.*, when $L = l = l'$ and $C = c = c'$, the equations of motion become simplified. We then have

$$\alpha = \frac{1}{c'(l' + \mu)} \qquad \beta = \frac{1}{c'(l' + \mu')} \qquad B = \frac{q - q}{2} \qquad E = \frac{q + q}{2}$$

Consequently if we make the initial charges equal and of the same sign, $B = 0$, and there is but one frequency of oscillation in each circuit, namely, $\frac{\sqrt{\beta}}{2\pi}$ cycles per second. If, however, the initial condenser charges are equal and opposite $E = 0$, and the upper frequency only occurs in each circuit, namely $\frac{\sqrt{\alpha}}{2\pi}$ cycles per second. In these cases the frequency of oscillation changes from

$$\frac{1}{2\pi\sqrt{c'l'}} \text{ to } \frac{1}{2\pi\sqrt{c'(l' + \mu')}} \text{ or to } \frac{1}{2\pi\sqrt{c'(L' - \mu')}}$$

respectively.

If at the moment of releasing the systems from their initial constraint ($t = o$) there are also currents I and i, flowing in the two circuits, respectively, then additional terms must be introduced into equations (1) and (2). These are:

$$A \sin \sqrt{\alpha}\, t + D \sin \sqrt{\beta}\, t \quad \text{into} \quad (1)$$
$$\text{and } a \sin \sqrt{\alpha}\, t + d \sin \sqrt{\beta}\, t \quad \text{“} \quad (2)$$

$$\text{where } A = \frac{-I}{2\sqrt{\alpha}} \times \frac{CL - cl - \sqrt{m}}{\sqrt{m}} - \frac{i}{\sqrt{\alpha}} \cdot \frac{C\mu}{\sqrt{m}} \qquad (8)$$

$$D = \frac{+I}{2\sqrt{\beta}} \times \frac{CL - cl + \sqrt{m}}{\sqrt{m}} + \frac{i}{\sqrt{\beta}} \cdot \frac{C\mu}{\sqrt{m}} \qquad (9)$$

$$a = \frac{-i}{2\sqrt{\alpha}} \times \frac{cl - CL - \sqrt{m}}{\sqrt{m}} - \frac{I}{\sqrt{\alpha}} \cdot \frac{c\mu}{\sqrt{m}} \qquad (10)$$

$$d = \frac{+i}{2\sqrt{\beta}} \times \frac{cl - CL + \sqrt{m}}{\sqrt{m}} - \frac{I}{\sqrt{\beta}} \cdot \frac{c\mu}{\sqrt{m}} \qquad (11)$$

The effect of introducing a small resistance into the oscillator circuits and thereby attaining a realizable system is to slightly modify the values of the two frequencies set up, and to cause the oscillations to subside logarithmically. The equations of motion are very complex. It will generally be sufficient to determine the motion by the above equations without damping or resistance, and then determine the rate at which the oscillations subside.

When three oscillator circuits are inductively associated, three frequencies are developed in each circuit, exceptional cases excepted. Similarly the linking together of n oscillator circuits produces n frequencies in each circuit.

Lighting Systems in Russia.

BY M. LUTOSLAWSKI.

Russia and the almost unpopulated regions of America should show certain analogies in consequence of their mutual scarcity of civilization, but at the same time they exhibit a striking contrast regarding the ways in which progress advances in the two countries.

The circumstances under which technics develop in Russia must really appear inconceivable to an American. With the exception of two or three large cities, there has been indicated only very recently a demand for electric light plants. In order to supply this apparent necessity of progress some local companies have been formed for the purpose of competing with the agents of foreign firms, generally German firms, which so far have had no competition.

The manufacture of electrical apparatus is still entirely undeveloped. Outside of the works of the firm of Siemens & Halske, in St. Petersburg, there are only two or three small factories, and these manufacture dynamos under licenses from foreign firms. Large installing firms have gradually grown up, among whom the firm of Podobjedow, in Moscow, has been up to the present the leading one. A few months ago a new company, "Electricity" (Towarzystowakcvjne Elektrycznosc), was formed in Warsaw, to some extent backed by the Allgemeine Electricitats Gesellschaft, in Berlin. This is one of the few firms constructing central stations and electric roads.

The above firms and the various agents of foreign houses have received of late numerous inquiries from small and large towns which intend to improve their systems of illumination.

Most of these negotiations, however, do not lead to actual business, as the electrical houses cannot accept the conditions made by the town authorities. Several reasons tend to explain this. First, the lack of luxuries in general, and of light in particular, is in Russia so striking that the corresponding data would simply appear incredible to an inhabitant of the Western Continent. A small city, say of 20,000 inhabitants, expends as a maximum annually 1500 to 2000 rubles ($750 to $1000) for illumination. This, however, does not imply that the town really is lighted to an extent equivalent to that which should be obtained with this amount; large sums are employed to increase in such illegal but quite customary way the insufficient salary of some members of the town authorities, and the electrical contractor must agree to conditions which secure to himself an extra profit and permit of bribing people having any connection with the question.

The lights burn only on the nights and at the hours when there is no moonlight indicated on the calendar, and burn during the prescribed hours only when a higher government officer may be present who is not accessible to the usual limits of corruptibility, or if any other important personage of rank is expected.

Second, the knowledge of technics and of the cost of plants is extremely small, so that the town authorities have no idea of the cost of the plant they need, and in most cases break off negotiations after receiving an estimate from the electrical contractor. The cities usually agree to increase their expense for illumination a little when the introduction of electric lights is intended, but at the same time the authorities increase enormously their pretensions regarding the quantity of light and the number of lamps. For instance, the city of Bialystok, a manufacturing town of 60,000 inhab-

itants and about fifty factories, is illuminated by 300 petroleum street lamps involving an annual expense of 2900 rubles ($1450). The city would now like to have an electric plant comprising fifty arc lights and 300 incandescent lamps, for which it is willing to pay 6000 rubles annually, corresponding to about six kopeks (three cents) per kilowatt hour, a price which would far less than cover the operating expenses. A big business is not to be expected from private customers as neither citizen nor nobleman is inclined to consider innovations favorably, and the Jews, being the chief portion of the population, are very close and free from all desire for comfort and luxury when it may cost them anything.

One more unfavorable circumstance comes into question regarding the erection of electric light stations. The ground is extremely cheap and therefore is not considered in building up cities. Even in small towns the distances are very great in comparison to the estimated demand for light. In Bialystok it would be necessary to light 30 kilometers of streets, and the estimated demand for incandescent lamps would hardly reach 2000.

The above mentioned conditions have to be considered in selecting a lighting system. First of all the plant must be very cheap and the cost of running must be a trifle; but as coal is cheap in Russia the cost of running may be considered as low. On the other hand, the simplicity in manipulation and safety in running must be insured because the labor to be had, though cheap, is hard to educate. This condition disfavors any attempt to comprise parallel aggregates of alternating current, which, however, providing the use of alternating currents is at all considered, cannot be avoided, owing to the great fluctuations in the demand for light, and in view of the necessity to save the possibility of enlarging the plant. On account of the great distances the alternating current seems to be preferable to the continuous current, while, on the contrary, it is advisable to avoid too high tensions because the novelty of the thing excites too much curiosity in a country where so little advancement in civilization exists, thus introducing danger.

The difference in the cost between operating with alternating and direct currents rests, in fact, only in their relative efficiencies, For direct currents it is apparent that aside from the smaller losses (no existing transformation, induction, impedance) the possibility of using accumulators affords great facility of operation, notwithstanding extremely great differences in consumption between day and night hours and between the night hours before and after midnight.

For reducing the cost of running, incandescent lamps should have preference over arc lights, because their renewal costs considerably less than the arc light carbons. In the cost of the plant the extension of the wiring is such an important item—principally on account of the high price of copper (generally over one ruble per kilogram)—that it is at first necessary to look for any possible reduction therein. It can be obtained apparently in the best way by the series system, which of course must be adapted to the circumstances described. As only medium tensions may be employed here, easily reached with either the alternating or continuous currents, both systems are equally applicable, and continuous current even preferable for higher tensions, being freer from danger than is the case with alternating current. But the series system is only applicable to street lighting, and the employment of continuous current presents the disadvantage that, besides the high tension machines being unapplicable to house illumination, there may be special arrangements for this purpose.

Notwithstanding, this system has found application. The city of Czestochowa, in Poland, has acquired of late a lighting plant consisting of thirty arc lamps. The plant cost 18,000 rubles, and is run by a contractor who receives 5400 rubles annually. House illumination is, of course, not provided. If, however, outside of the public illumination a certain amount of private illumination should be attempted, and it is not desired to work with several installations of machines of various types, then the alternating current must be used. The high tension is employed in the streets in the series system and as primary current in suitably located transformer substations, while the house illumination is supplied at normal tension from the secondary circuit of the transformer.

In order to comply with the requirements of cheapness, economy and easy manipulation the writer employs three-phase currents and series of lamps connected in star-like system to a neutral circle wire. In this way only a minimum conductive material is necessary. Care should be taken to arrange overhead conducting systems so that only wires of the same polarity are strung on one pole, reducing the danger of the high tension to a minimum, provided everything is well insulated from the earth.

This arrangement possesses several advantages. For instance, three series of lamps may be extinguished without any influence on the other lamps. If it is desired to extinguish the series independently of each other, it can easily be done by inserting inductive resistances. The latter may be arranged in the form of choking coils with adjustable magnetic resistance to make it possible for any desired number of lamps in one or more series to be extinguished or kept burning.

The region to be lighted is surrounded by a ring circuit which serves as a circuit of equalization and is connected at several points with the neutral pole of the generator. From the other poles of the generator the conductors radiate into the city, connecting the included series of lamps to the circle wire.

The system involves certainly all the difficulties which belong to the series system in general. In arc lighting it is relatively easy to overcome them, although series of arc lamps are not by far so generally employed in Europe as they are in America. Since the system of the Westinghouse Company led the way in this direction, numerous firms of the Continent have experimented with and perfected systems of such series with suitably constructed lamps and systems of distribution.

It is much worse with incandescent lamps in series, which would have the most chance for general introduction in Russia, on account of the above-stated reasons. In this also the system of the Westinghouse Company has found great application, through the Helios Company, which illuminated the Nord-Ostsee Canal by this system. As is well known the system consists in connecting the incandescent lamps to choke coils in the shunt circuit. Through these coils the whole current passes when a lamp burns out, whereby, through the apparent resistance of the spool, such a drop in the potential occurs that the voltage for the other lamps remains the same.

A Polish engineer, Alex. Rothert, in the employ of the Frankfurt firm Electricitats Actien Gesellschaft, formerly Lahmeyer & Co., has recently suggested a system which seems in general to be superior to the choke coil system and which appears to be especially likely to find a favorable application under present circumstances. It is similar to the described system of the Westinghouse Company. The reaction coils in the Westinghouse system are simply replaced by single transformers (*Electrotechnische Zeitschrift*, 1896, No. 10). For regulation of the tension the transformers act as well as the coils, because their secondary circuits remain open when a lamp burns out and the whole line current then acts as magnetizing current in the primary with a reactive tension 90 degrees behind it in phase. This tension composes a resultant with the sum of the primary tensions of the still active transformers which differs but very little from the whole original tension, whereby the regulation is effected in the way described by the inventor. The efficiency of this system is, as compared with the choke coil system, a trifle smaller with the same weight of copper and iron, that is, at the same cost. The space occupied by coils in the former system has to contain both coils in the transformer, so that the density of current and the loss of current by heat must be greater. This, however, is not of so much importance in Russia. On the contrary, the advantage that the lamps can be reached while in operation is very great, the lamps being completely away from the high-tension current and therefore the operation of the lamps is free from danger. It was stated above how much this has to be considered in Russia on account of the unskilled character of the only labor at hand. The advantages of this system, which permits of selecting any number of lamps from one series and any voltage, must, in conclusion, be pointed out. These two important conditions only influence the ratio of transformation, which is equal to the tension of the system divided by the number of lamps of one series and divided by the voltage of the lamps, which according to circumstances may be one of those usually employed.

This system of distributing light is destined to find general application in Russia in view of the reduction of the first cost of the plant and by virtue of its simplicity in operation. At present it is under test by the above-named company. It will probably help to bring about an understanding between the close and saving town authorities and the contractors who don't care to take big risks.

Calculation of Lines for Three-Phase Lighting Systems.

The calculation of circuits for the three-phase system, when it is used for lighting, involves a number of difficulties owing to the fact that the three circuits may be unbalanced by there being a different number of lights burning on each circuit, and in order that the changes in voltage should not be too perceptible the circuits must be carefully calculated; in this respect they differ from such circuits when used for motor service alone.

The current numbers of the *Elektrotechnische Zeitschrift* contain a very good discussion of the subject by Mr. Hermann Cahen, and as his conclusions are of considerable interest we give here a full abstract of his article.

As the three-phase system is now coming into use for smaller lighting stations, a simple method of calculating the lines is of importance. In the following the term lamp voltage for the difference of potential at the lamps, the term principal voltage for that between two lines, and the term phase voltage for that between each line and the middle point of the system will be used; the relation of the principal voltage to the phase voltage is $\sqrt{3} = 1.73$; by the term voltage and current the effective values are meant.

In calculating the lines a distinction must be made between two systems, according as the lamp voltage is equal to the principal or to the phase voltage, that is, the triangular system and the star system. The first is similar to the usual two-wire continuous system, in which the highest possible voltage is equal to the lamp voltage; the second is analogous to the three-wire system. with the difference that the voltage in the outer wire is 1.73 times the lamp voltage. The calculation of the cross-sections requires that one knows the exact disposition of the whole network; this can be

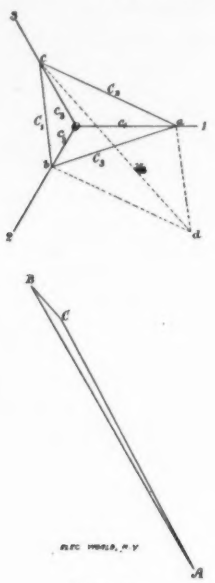


FIG. 1.

done in two ways; the whole space may be covered by three or by four wires, between which the lamps are balanced, or each group of lamps can be installed according to the simple two-wire system from a distribution point where it is connected with three or four wires to the generator. The first arrangement requires a less amount of material, but the calculation of the wires is more cumbersome. The second system has the advantage of simplicity and the groups can be changed from one phase to the other. In large installations the second will therefore in general be preferred, while in small ones the first is the better.

A maximum loss of voltage must be assumed at the start. Considering first the system in which the distribution is from one point, he assumes the load is equally divided among the three phases; the loss of voltage on the lamp wires will then be equal to

$$v = \frac{c\,L}{k\,q}$$

in which c is the current, L the length in meters from the source, as for instance the transformer, k the conductivity of copper and q the cross-section of the wire, all in the metric system; this is for the triangular system. For the star system the formula is

$$v = \frac{c\,L}{3\,k\,q}.$$

In both, the loss of voltage due to induction is neglected.

These formulas apply only when the loads are equally balanced and it is therefore of importance to be able to calculate the changes for unequal loading. As the analytical method is too difficult he uses a graphical method. In the accompanying diagram, Fig. 1, the lines *O1*, *O2* and *O3* are at 120°, and on these the three currents are laid off as c_1, c_2, c_3; the connection between the end points *a*, *b* and *c* will then give in amount and phase the values of the currents c_1, c_2, and c_3; for an unequal load therefore the currents are unlike and are shifted in phase; they are largest when the system is balanced; the losses of voltage v_1 v_2 and v_3 in the lanp wires are obtained by finding the resultants of the respective losses in the wires, that is, *d a*, *d b* and *d c*, the phases of which will in

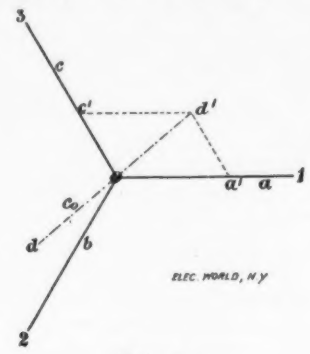


FIG. 2.

general be different from those of the lamp currents. To obtain the lamp voltage these must be deducted from the principal voltage in phase with the lamp currents. If *A B* parallel to c_3 is made equal to this mean voltage, and *B C* parallel and equal to the loss represented by v_3, then the lamp voltage is in amount and phase equal to *A C*. In practice a mere subtraction would in general be sufficient.

From this diagram the important conclusion can be drawn that the current as well as the lost voltage in the triangular connection have their maximum values at full load on all three phases, and they will be less for every other load; the wiring may therefore be calculated for the maximum load.

Quite different results are obtained from the star system, as the middle wire carries a current when the load is unequally distributed. Referring to Fig. 2, the lamp currents are again laid off in the three directions, as *O a*, *O b* and *O c*. The current in the neutral wire is obtained by taking the excesses of the two largest currents and obtaining their sum geometrically in the form of a resultant, thus giving *O* c_0 in amount and phase. Another method is to construct an incomplete triangle with its sides equal and parallel to the three currents, then the line joining the extremities (thus forming a four-sided figure) gives this current in phase and amount.

To determine the losses in voltage the fact that the middle wire

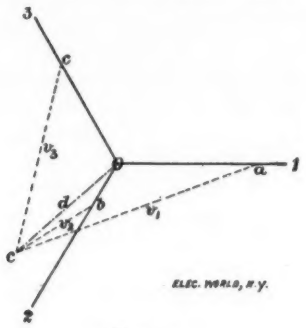


FIG. 3.

has a different cross-section must be taken into consideration. If in Fig. 3 the distances *O a*, *O b* and *O c* are the losses in the wires, then *O e* will be the loss in the neutral wire; it must be corrected for the different cross-sections. The losses at the lamps are then the connecting lines *e a*, *e b* and *e c*, which are not in the same phase as the voltage, but the diagram will show whether it is necessary to take this into consideration. As the diagram shows, these losses can even be negative, that is, the voltage may be greater than that of the source.

In order to find between what limits the current and voltage can change in the neutral wire, he shows that there are three cases for

which the neutral current has its largest value; namely, when two of the phases are unloaded or when one is at load full and the other unloaded. In the star system, therefore, it is much more important to have the load equally distributed than in the triangular system. It is even more difficult in the star system than in the three-wire system, for the probability that there are three equal loads is always less than that there are two equal loads. Furthermore, in the three-wire system there are only two unfavorable cases, while in the star system there are six. The triangular system, on the other hand, has the disadvantage over the star system that every lead belongs to two phases, so that if one lead fails two-thirds of the whole lighting is interrupted or is running at half the voltage; it is therefore improper with this system to disconnect the wires singly, while with the star system this is to be recommended. It would be better in the case of the star system either not to fuse the neutral wire at all or to fuse it with larger fuses than in the outer wires, in order to prevent in most cases opening the neutral circuit.

He then shows with examples how these are applied. With the triangular system the equation given can be used directly for calculating the cross-section. With the star system it is necessary to know how far an unequal loading must be taken into consideration. There are two extreme cases, one in which an unequal loading need not be considered at all, as when all lamps are burning at the same time, in which case the formula can be used directly and a very small cross-section for the neutral wire will then suffice; in the other case the most unfavorable distribution must be considered and the allowable loss must not exceed that in this case. The most unfavorable case is that in which two phases are without a load while the third and neutral carry the maximum current; the loss of voltage will then be the sum of that in the two wires, taking into consideration the different cross-sections. Equations are then given for the two cross-sections in this case so that the weight of copper is a maximum. The results thus obtained for the star and the triangular system give as the relation of the former to the latter 0.83; the amount of copper in the star system, even for the most unfavorable cases is therefore about 17 per cent. less than in the triangular system. This is illustrated with an example.

In practical calculations neither of these extreme cases would be used, but instead the most probable unfavorable case would be used as a basis in a similar way in which it is done with the three-wire system. He recommends, in the three-phase system, to use a larger relation between the cross-section of the neutral and outer wires than with continuous currents. Taking this into consideration, it will be found that the saving of material is not very much greater in the star system than in the triangular system, on account of the fourth wire, the insulation and erection of which compare with the saving in copper. If, however, it is possible to use for the neutral wire an uninsulated copper wire buried in the earth the star system will in all cases involve an important saving over the triangular system. In this case practically the total loss of voltage should be in the outer wires.

In conclusion he calculates as an example a case in which there are eighteen arc lamps on six branches of three lamps in series, each using the star system, this being a case where in general that system is the better, as the circuits are as a rule quite long and therefore their cost is of importance. The necessary regulating resistances, as the six groups of three in series are connected in multiple on a constant potential system, are best made largely of the resistances of the leads; their accurate determination is therefore of importance.

X-Rays to Detect Smuggling.

A dispatch from Paris states that the French Government has adopted the X-rays as a means of checking the prevailing practice of smuggling. Drector Pallain, of the French customs service, has ordered that Crookes tubes be kept at all the larger customs offices, and all of the customs inspectors in Paris have been summoned to the chief office to have the method of their use explained to them. Hitherto vast quantities of watches, jewelry and other dutiable articles of high valuation have, it is stated, been concealed by stowing them in the legs of deal tables and ink receptacles, and have thus escaped the notice of the customs officers. It is believed that by means of the X-rays the presence of such articles will be readily detected.

Electricity for Mill Purposes.

In a paper read by Mr. Frank P. Sheldon before the New England Cotton Manufacturers' Association, that gentleman gives some interesting figures regarding the cost of production of power in New England. No rule can be laid down, he says, by which the advisability of using electrical transmission of power may be determined for all cases. Every case must be studied individually and decided upon its own merits, as various elements enter into the questions involved. In cases of large amounts of power the question is one of economy of operation; in others it may be one of convenience or feasibility, ignoring the cost to a greater or less extent.

In transmitting electric power in large amounts to cotton mills, the standard of comparison is with modern steam plants, which in New England produce a horse-power for about $15 a year of 310 days of ten hours each, this cost including fuel, oil, waste, labor, taxes, interest at 5 per cent., and depreciation 5 per cent., with fuel at $3 per ton. At $4 per ton, the cost will be increased to about $17 per year. Where cheap fuels can be used the cost will be less. In comparison with the above the installation of water power with electrical transmission would not be justifiable on account of high initial cost and losses in conversion and transmission. If the mill desires to install a lighting plant and has surplus water to furnish power for it, it will sometimes pay to do this, using the same apparatus to transmit power to motors in the mill when the lights are not in use. The charge against the power then consists in the motors only, and may be advisable and advantageous.

The most economical way to light a mill which uses either water or steam as initial power is the combination of a generator and storage battery, the generator being connected to the mill shafting at some convenient point. The installation of electrical generators and storage batteries to accumulate power from surplus water outside of mill hours will not pay, generally speaking, owing to large initial cost. There may be peculiar conditions, however, in some cases which might make it advisable. In general, it may be said that electrical transmission of power for cotton mills is feasible where convenience, feasibility, intermittent use, unusual hours, etc., are to be considered, rather than economy of power. These uses apply equally well to all other industrial establishments, and are not peculiar to cotton mills.

In the installation of a lighting plant for a cotton mill, it is well to consider the possibility of using small motors for various purposes, and they can be applied with moderate cost at any time. In conclusion, Mr. Sheldon stated that the advisability of using electric power must be determined in every case by a careful study of the pros and cons.

Exports of Copper.

The exports of copper from the United States for June last reached a total of 12,709 tons, which is the largest quantity on record for any one month, except September, 1893, and December, 1896. The export movement has been a heavy one for nearly two years past, Germany being the largest purchaser at the present time, while France and Russia are also taking large quantities. The bulk of the metal is used for electrical purposes, such as trolley and telephone wires. *The Engineering and Mining Journal* states that so far this year the United States has exported over half its copper production, the exact figures being 58.6 per cent. The output has continued large, having reached, during the five months ending with May, a total of 88,998 long tons. This shows an increase of 3643 tons over the very large output of last year, but the gain was a little more than absorbed by the increase in exports, which were this year 52,193 long tons, or 3672 tons more than in 1896. Our own consumption has remained about stationary. Notwithstanding the increase of exports from this country and the increase in production from European mines, during the first five months the stocks of copper in sight have diminished. The price of the metal has been well maintained, and there is even at the present time an upward tendency. This is based entirely upon the demand, for there has been this year very little speculation in the metal, and the large demand for our own industries could be met only by a further increase in production.

Niagara Power.*

BY L. B. STILLWELL.

It is unnecessary to demonstrate to this audience that well-distributed acquisition of material wealth is desirable, and tends to advance civilization. It will be conceded at once that a wise and not wasteful utilization of natural forces, cheapening the cost of power for a community, is praiseworthy. We all believe that there is in the universe a certain fixed quantity of matter, which we are powerless to increase or decrease, and we accept the doctrine, first fully enunciated by Helmholtz, that Nature provides also a fixed quantity of energy, to which we can add nothing and from which we can take nothing away.

A man, considered as an engine, and compared with the vast supplies of energy available in coal and falling water, is capable of but an insignificant amount of work. It has been calculated that a very strong man, exerting himself very violently, can, for a few minutes, work at a rate approximating one-fifth of a horse-power; but we have only to remember that one-fifth of a horse-power means 5600 foot-pounds per minute, and that this is equivalent to lifting 110 pounds one foot every second, to perceive that the calculation does not apply to the average man performing continuous work by the hour. Considering work continued for ten hours per day, I think it is safe to say that the average output of fifty strong laboring men, working steadily and faithfully, would not exceed one horse-power; and it is probably no exaggeration to say that the power of Niagara exceeds the physical power which the whole human race is capable of continuously exerting.

Niagara is a great solar engine. You all understand the cycle. Water raised by the sun from sea and lake and river is precipitated to the earth by changes of temperature, finds its way into the Great Lakes, and thence, by the Niagara River, to the rapids above the falls, more than 200 feet above the level of the water in the gorge immediately below the cataract. To raise a pound of water from the river below the gorge to the head of the rapids, a force of one pound must be exerted through a distance of, say, 200 feet. Therefore, every pound of water at the upper end of the rapids represents 200 foot-pounds of energy, which are given up in falling to the lower level. The rate of flow exceeds 7000 tons of water per second, and the total horse-power is estimated (by the United States census of 1880) to exceed 5,800,000 horse-power. That is an enormous amount of power. Let us see how much coal we should have to burn to develop as much. A committee of the National Electric Light Association several years ago made a systematic effort to ascertain the economy in the consumption of coal obtained in electric light stations throughout the United States. The final report of this committee is not before me, but the preliminary report, submitted at the convention in St. Louis, March 1, 1893, showed that the average consumption of coal in these stations per horse-power hour, measured, as I understand, by electrical measuring instruments on the switchboard, slightly exceeded six pounds. At this rate it would be necessary to burn more than 130,000,000 tons of coal per annum to develop power equal to that of the Niagara River from the upper limit of the rapids to the gorge below the falls. This would be substantially one-third the coal product of the world, and would materially exceed the entire amount of coal now used for power purposes. With the best of modern steam plants, the consumption of coal would still exceed the entire annual output of the anthracite coal fields of Pennsylvania. Making all necessary for loss in a hydraulic plant, the power of Niagara Falls, if it could be utilized as a whole, would supply more than 3,000,000 arc lamps of 3000 nominal candle-power each. An idea of what that number means may be obtained by imagining a row of arc lamps on either side of a railway track extending from New York to San Francisco. Were the number named available, 2000 candle-power lamps might be located on either side of the track at intervals of twelve feet throughout the entire distance. Expressed in terms of 16-cp incandescent lamps, there is sufficient power to drive 600 generators like those now installed in the power house of the Niagara Falls Power Company, each of which supplies energy equal to that required by about 75,000 50-watt lamps; or, to put it in still another way, the power of Niagara, if used for the refining of copper by electrolysis, would deposit more than 2000 net tons per hour.

There is an important difference between using the energy of coal and utilizing the energy of water powers for power purposes. Coal once burned cannot be used again. Water powers, on the other hand, are solar engines perennially renewed. We may utilize the energy of Niagara to-day without subtracting a single horse-power from that which Nature intended not only for our age, but for future ages. The thought, therefore, immediately suggests itself that we should, so far as possible, utilize our water powers in the mechanic arts, burning coal only for our protection from cold, for the preparation of food, for necessary metallurgical purposes, etc. If this be impracticable, we should at least see to it that our utilization of the energy of coal does not involve undue waste.

Of course, not all of the power of Niagara can be utilized. Aside from aesthetic considerations, which will, perhaps for all time, prevent the utilization of a sufficient amount to impair the beauty of the falls, and considering the subject simply as an engineering problem, large deductions from the figures above named must be made to cover the difference between the total and the effective head, this difference representing the fall in canals and tunnels conveying water to and from the wheels. I suppose that it would be possible to deliver about 4,000,000 horse-power to the turbines, and of this amount the turbines would deliver about 3,200,000 horse-power at their shafts.

At this point—the shaft of the turbine—engineering science for a long time halted. Water wheels appear to have been used at least 2000, and probably 4000, years ago, though not extensively. Every water wheel necessarily had a shaft upon which it was supported and about which the blades revolved. The problem was, how might the power be conveyed from the shaft to a point where it could conveniently be made to do work? Naturally enough, men first used for this purpose something they could see and handle and readily comprehend. They used wooden shafts, then ropes and belts. Then some one thought of using a liquid, and the science of hydraulics began. Still later, somebody suggested using a gas—compressed air—and pneumatic transmission attempted to solve the problem.

When the officers and directors of the Cataract Construction Company came to decide what methods of developing and distributing the power of Niagara should be adopted, they faced a problem of transcendent importance. It involved far more than the mere capital to be invested; it involved, in no small degree, the future development, the prosperity, of a territory bounded by a circle having for its radius the utmost distance to which the future advancement of engineering science might make it possible to transmit power; and the decision of the company carrying a project inaugurated on so vast a scale, occupying so conspicuous a position in the eyes of the scientific and engineering world, must inevitably exert a powerful influence npon the great world problem of the economical utilization of our supplies of natural energy. To utilize and distribute over the widest range, with the least waste, with the greatest certainty, and in form adapted to the widest variety of applications—these were the conditions to be met. To enumerate them now is to suggest to all our minds, with absolute certainty, electricity, the Proteus of engineering science as it exists to-day; but it must be remembered that when those who inaugurated and have thus far carried out the project began their study of the problem, the possibilities of electricity had not been demonstrated and recognized as they are to-day. At that time, the relative advantages and the limitations of water, air, rope transmission and electricity were less evident than now, and it was necessary to examine with great care, and weigh with accurate judgment, the merits and defects of many different plans. This the company proceeded to do with remarkable patience, thoroughness and ability, inaugurating a competition which many of the most prominent engineers and manufacturing firms of Europe and America were invited to enter, and offering prizes for the best solution of the problem. The question was in no sense begged at the outstart. The company did not select electricity because it was the newest agent for transmitting power, nor because the general public was (as it still is) disposed to assume that electricity is necessarily the agent best adapted to the solution of every engineering problem. They arrived at their decision to use electricity only after several years of investigation, in which, practically without regard to cost, they endeavored to secure the best of engineering talent, and in which they allowed no prejudice and no difficulty to narrow or limit their cosmopolitan search for the best solution.

Let us consider very briefly some of the limitations to which our various methods of transmitting power are subject. For obvious

*A lecture delivered before the National Electric Light Association at the Niagara Falls meeting.

reasons, transmission by shafts, ropes and belts is effective and efficient only over comparatively moderate distances. A shaft, for instance, even a hollow shaft, if strong, is necessarily heavy. It must be supported and carefully aligned. To effect a change in the direction of transmission, special devices, such as gears and pulleys, must be used. All this means loss of efficiency at every step, and the economical limit is soon reached. In the case of transmission by ropes or cables, also, loss of efficiency results from the necessity of supporting the weight, and sharp turns are difficult to make, and imply heavy losses.

Hydraulic transmission is also limited to comparatively short distances. Under certain conditions, and for distances not exceeding two or three miles, it is used with good results. The municipality of Geneva, Switzerland, under the able direction of Col. Theodore Turrettini, foreign consulting engineer of the Cataract Construction Company, has established a hydraulic plant for the distribution of power throughout that city, which has been splendidly successful and is worthy of most careful study. Colonel Turrettini and the municipality of Geneva, however, recognize the superiority of electric transmission over distances exceeding a very few miles, and they have more recently constructed a second power plant some four miles further down the Rhone, in this case using electricity to transmit and distribute the power.

Some of the causes that limit the distance to which power can be economically transmitted by water will readily occur to you. For example, the amount of power transmitted by water through a pipe by water under pressure is proportional to two things—the quantity of water that flows through the pipe in a given time, and the head or pressure. Friction increases with pressure, and also with an increase in the length of the pipe. Then, the efficiency of water motors, particularly those of comparatively small output, is low as compared with that of electric motors. Again, the chance of water freezing in the pipes must be considered; and a limitation, not frequently encountered in practice, but still worthy of note, results from the fact that water, unlike electricity, has weight. If we were to undertake to carry a pipe line filled with water over some of the mountain ranges now crossed by electric conductors, we should have a pressure in the pipe, at certain points, of not less than 1500 pounds per square inch, due to the greater elevation of other parts of the line.

The limitations of pneumatic transmission have not been accurately determined, and it is probably possible to obtain better results by this means than have as yet been realized in practice. Air compressors, however, have been made for many years, and as compared with electric generators, are much less efficient. To compress a gas means necessarily to develop heat, and this, so far as our purpose of transmitting power is concerned, involves loss; and while it seems probable that by using very high pressure in pipes of comparatively small diameter the cost of a system transmitting by compressed air may be much reduced, as compared with present practice, there are certain difficulties to overcome, and up to the present time no satisfactory method of surmounting these difficulties has been demonstrated.

The fourth solution of the problem of transmission is by electricity; that is, by ether under unbalanced pressure. Note, if you please, the interesting sequence of the several solutions of this problem of transmitting power: First, a solid; then, a liquid; then, a gas; and, finally, something (if I may use the expression) more volatile, more subtle, even than a gas; something which, in itself, we can neither touch, taste, smell, hear, nor see; something that we know only by its effects; something so elusive that for centuries the world did not know that it existed. Is it not significant of the progress of engineering science that it should thus have advanced from those agents directly perceptible to our senses to one which our physical senses cannot perceive—from the material to the immaterial?

And, now, what is ether? What is electricity? And how is power transmitted by electricity? These are questions that the science of the present day cannot fully and satisfactorily answer. But we are not totally ignorant of the nature and characteristics of this agent that we are using with such confidence and assurance of results, and it is not difficult to form in our minds a rough conception, useful as a working hypothesis, though not susceptible of proof, and very properly subject to criticism from various points of view. We know from optics that there is a medium that is not a solid, not a liquid and not a gas. We may exhaust the air from a glass vessel and light will still pass through it. Air, therefore, is not the medium by means of which light is transmitted. Evidently, there is something still in the glass vessel which serves to convey the ray of light. We know, also, that the space between the earth and the sun is not filled with air, and yet it is traversed by light. We assume, therefore, that the interplanetary spaces are filled with this same something, and, for convenience, we call it ether, and proceed to study its phenomena. The science of optics which deals with the propagation of light through this medium is so well established by observed facts and by general theories which explain and interconnect these facts, that practically nothing within the range of human knowledge is more certain than that something which we call ether does exist, and that it pervades all space and all matter. In 1888 the German physicist Hertz proved beyond the shadow of a doubt that electric and magnetic phenomena have to do with this same medium.

Electricity is defined as ether in a state of strain, or, more properly speaking, in a state of unbalanced strain; this strain manifesting itself along the conductors of an electric circuit connected at one end to a dynamo in action, and at the other to a lamp, motor, or other translating device. Professor Lodge advises us to conceive of an electric conductor as a hole through the ether. The static balance of the ether being relieved or unbalanced along the surface of the conductor, and the strains to which our world of ether is subject (somewhat as water at the bottom of the sea is under pressure) being unbalanced along the line of the circuit, the ether transmits along the surface of the conductor the strain or pressure imparted to it by the dynamo. We need not pause to consider whether the strain is transmitted by the ether within the copper conductor or along its surface, but we may imagine that following the path of the conductor from the dynamo to the motor, and back again from the motor to the dynamo, a loop or chain of ether transmits a stress or strain from the dynamo to the motor, somewhat as a belt conveys power from a driving to a driven pulley.

In the telegraph, and more recently in the telephone, we have become familiar with some of the characteristics of electric transmission; notably, the fact that it is practically instantaneous in its action. We press a key in America, and the mind of an operator in England almost instantly has our thought.

We are less familiar with the fact that electricity is strong, but observations of thousands of street railway cars driven at high speeds and up heavy grades, and of motors operating heavy machinery in mills and factories, is teaching us this also. As a matter of fact, the power transmitted through a copper conductor of given section, at the potential now being employed by the Niagara Falls Power Company in transmitting power to Buffalo (between 10,000 and 11,000 volts), is sufficient to break many steel cables of equal section moving ten miles per hour and attempting to transmit equal power. At 10,000 volts, a single-phase circuit, consisting of a copper conductor one inch in section and carrying 1000 amperes, transmits more than 13,000 horse-power. The strain upon a cable transmitting this amount of power mechanically and moving ten miles per hour would exceed 1,000,000 pounds—enough to break eight steel cables one inch in section, and having the high ultimate tensile strength of 125,000 pounds per square inch. In three-phase transmission, such as is used between Niagara and Buffalo, the results in this respect are still more remarkable, but to consider three conductors makes our comparison with a steel cable less evident.

Power transmitted by electricity is delivered in a form adapted to a remarkable variety of uses, and, as compared with power transmitted by any other system, possesses important advantages. Supplied to a motor, it performs mechanical work at efficiencies ranging from 60 to 95 per cent., depending upon the size of the motor. Delivered to an arc lamp, it produces from 1500 to 2000 actual candle-power per horse-power. Used to supply incandescent lamps, it produces light agreeable in quality, possessing substantial advantages over other forms of illumination, and developing from 200 to 250 candle-power per horse-power. Conveyed to the terminals of the electric furnace, it produces, by synthetic process, various materials new in the arts and of great value, or, traversing the electrolyte of the chemist, it tears apart the very molecules of which matter is composed and segregates their constituent elements.

Unlike shafts, belts and cables, it can be indefinitely sub-divided without material loss. It can readily turn corners. It is transmitted vertically with as much ease as horizontally. Unlike water, it never freezes, and, unlike compressed air, it can be delivered from the generating machinery and transmitted many miles at a very high efficiency.

The Three-Wire 440-Volt Plant of the Canton Electric Light Company.

BY A. H. PERKINS.

Nearly every question as to the application of electricity to either new or old uses is not so much one of possibility as of finance—not "how," but "how much." The expansion of the electric lighting business is an example. All the very desirable franchises were disposed of several years ago. Still the continued improvements resulting in the cheapening of apparatus and lessening of running expenses, make further expansion at a slow rate possible. The franchises as such, however, are practically valueless, and can be made of value only by the most careful use of the money invested. The financial problems are of two classes, viz. (1) Given all the money desired, to invest all that will pay a reasonable return on the investment; (2) Given a fixed amount, to obtain the best results possible with it. Thus the question to use or not to use a feed-water heater would be answered under condition (1) by ascertaining whether it would save an amount of fuel equal to 10 to 20 per cent. on the investment required for the heater. Under the second condition, not only this question, but also: "Have we funds to do it with without sacrificing something of greater importance?" must be answered. Among the implements recently put into the hands of the engineer for the solution of these problems is the 220-volt system. I believe in the direct-current system for small towns. A system that does not furnish light at all times of night at least is scarcely

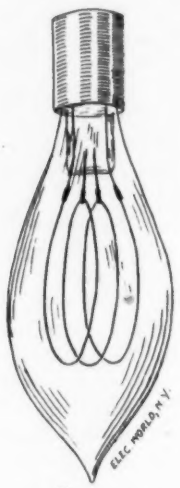


Fig. 1.

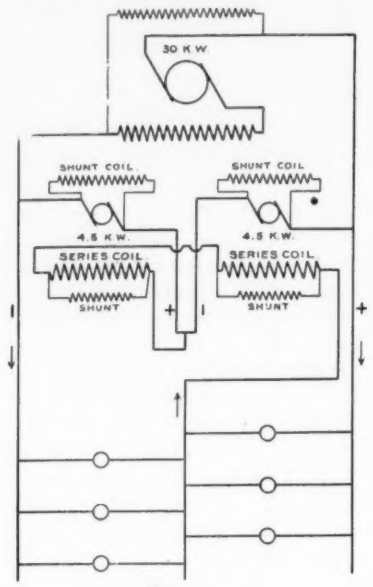


Fig. 2.

more than a plaything, and, besides, compels the customer to keep constantly before him the rivals of the electric service. It will always pay to put in some arrangement at the start for maintaining a constant service. For small towns, therefore, this practically limits us to the use of the direct current, since storage batteries operate only with this, and loss in transformers, and the inefficiency of small alternators, render the alternating current out of place for this service.

These considerations, the reports of the continued application of this system abroad, the statements of various lamp manufacturers in regard to their lamps, and the fact of the imposition of condition two, led the Canton Electric Light Company, of Canton, Pa., to adopt the 220-volt system, at first with reserve, and afterward completely.

Canton is a town of about 2500 inhabitants, the centre of a rich farming district and a residence of those engaged in tanning, lumbering, etc., in outlaying districts. It has two sources of water supply, one from a creek, about a half-mile from the town, through a 10-inch pipe, giving a standing pressure of about 95 pounds. This is the main supply. The other, used as relay, is from a lake, about one mile from town, through a 6-inch pipe, giving at the lighting plant a standing pressure of 140 pounds. The limit of the power to be obtained from this latter source is, of course, the size of the pipe. Owing to the flatness of the line at its upper end, this pipe will furnish only about 12 horse-power, and this is cut down by lack of efficiencies to 8.5 E. H. P. As a starter, the company installed two General Electric M. P.-4.5 1050 dynamos of 250 volts each, direct-belted to a No. 4 Pelton water motor, with governor. The idea was to give the 220-volt lamps a thorough trial. If they worked well, a 500-volt machine could be used across the outside mains for heavy loads, and the small plant used as light load plant. If the lamps did not work well a storage plant would be placed at the centre of distribution and 110 volts used.

Lamps of 225 volts were then ordered.

There were two principal causes of failure in these lamps.

(1) A long filament loosely anchored at the bottom of the bulb. The result is a lamp useless in any but a vertical position, and a poor device for that. The anchorage pieces break off with slight

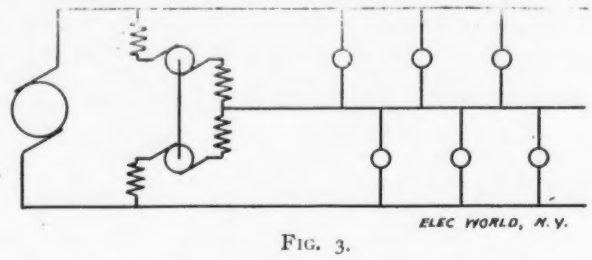


Fig. 3.

shock, and by their weight destroy the filament, or the filament springs, against the bulb, when turning on "drops" at the socket.

(2) The explosion of the lamps, due to poor vacuum (See The Electrical World, Vol. XXIX., p. 253). This explosion ranged all the way from blowing the lamp into fragments and giving a serious short circuit to the simple melting of the leading-in wires, without an injury even to the filament inside. All the lamps were subject to this to a greater or less extent. We must give the Edison lamp the credit of enabling us to use the 220-volt system. We have run an Edison 50-cp, 225-volt lamp at 500 volts for one minute without breakage of filament, and afterward used it for lighting for ten hours before breakage occurred. The Edison double-anchored filament 225-volt lamp would seem to be on a footing with the 110-volt lamp in every respect, except homogenity of filament. In other words, so far as the long-working life of a lamp is a matter of certainty, the 220-volt lamp is on a par with the 110-volt, but chance faults have twice the opportunity of creeping in. To illustrate, suppose we have two 110-volt, 16-cp lamps in series, and a 32-cp, 220-volt lamp. The breaking of one of the 110-volt lamps results in the loss of one 16-cp lamp. The breaking of the filament of the 32-cp lamp results in the loss of a 32-cp lamp, while the chances for either occurrence are the same. The Edison lamps have a solid anchorage from the top, as shown in Fig. 1.

We can report one very practical, though unscientific, test of the relative merits of 110-volt and 225-volt lamps. We wired a number of stores with two 112-volt lamps in series across our 225-volt lines. The underwriters compelled us to change these, and in every case the customer reported a markedly better light. The efficiencies were 3.5 watts for the 112-volt, and 4 watts for the 225-volt, and the unanimous decision in favor of the 225-volt lamp would indicate a less difference in efficiency or a difference in the character of the light in favor of the 225-volt. I believe there is a great deal to this character of light in practical working, and that our systems of photometry may be greatly enhanced in practical value by a scientific study of this point:

To conclude, in regard to the lamps, it would seem from our observations that the 112-volt, 3.5-watt lamp is at least no better nor longer lived than the 225-volt, 4-watt lamp.

The above results having been established, the company bought an Eddy 30-kw, 500-volt dynamo, direct coupled to a Harrisburg Ideal, 9 x 10 engine, and a boiler, 18 feet by 54 inches, putting the whole in operation about March 1, 1897.

The logical outcome of a 225-volt lamp is a 450-volt, three-wire system. The system that we now have is shown diagramatically in Fig. 3.

The water motor and small machine run continuously at present, it being necessary to start the engine about 7 o'clock on clear nights, shutting down about 11. From that time until 8 the next morning the water motor runs without attention, the attendant going home. We think this feature of our plant is very unique. The little water plant runs almost entirely without attention, the only trouble experienced being with the governor, which has a tendency to allow racing. At present we have a maximum load of 50 amperes at 500 volts, and burn from one-third to one-half ton of soft coal per night.

The difficulties that we have had are not chargeable to the 225-volt system as such, but are the results of the other peculiarities of the plant. The full 500 volts is not run inside any building, and, as was to be expected, the system gets out of balance. Since most of our lighting is at one point, however, this is not serious. I see no way to arrange an equalizing system for the operation of the series fields of the small machines while in parallel with the 30-kw machine. The result is that turning off lights on one side raises the voltage on that side and reduces it on the other—the reverse of what should occur—and this effect is quite marked, owing to its coming on a relatively small shunt dynamo. When the 30-kw dynamo is in operation, therefore, the voltage requires constant attention. I tried running the current in the neutral wire through the series fields of the small machines in opposite directions, so that, when one side was higher than the other, the series winding acted as an over-compounder on the high side and a differential on the other. This will be understood by reference to Fig. 2. By the use of suitable shunts, this accomplished its purpose to a nicety, but resulted in the occasional reversal of the polarity of one of the machines. For this reason we, at present, cut the series coils out during the operation of the 30-kw dynamo.

A relatively light "short" on the line on one side blows the fuse on that side of the small dynamo. This happens rarely, however, and we have another fuse block cap ready to slip in. I give these points as interesting in themselves, but they should not be regarded as necessary to the 225-volt system.

For interior wiring we use only the best double rubber-covered wire, run on separate knobs.

In conclusion, I may say that the 225-volt system used in connection with thorough work in wiring (without which no voltage is safe) is perfectly feasible and satisfactory.

The Spectrophotometry of Incandescent Lamps.

BY W. R. TURNBULL.

In the January 1, 1896, number of the New York *Electrical Engineer*, Dr. W. H. Birchmore published an article on "The Mistaken Ideal of Artificial Light Improvers." His curves are plotted from, and his paper is based on, a table of mistakes which unfortunately appears in Palaz's excellent book on "Industrial Photometry."

This table purports to come from O. E. Meyer, but the Beiblaetter reference[1] to Meyer's article gives tables which are, in their main essentials the same as the tables of other investigators.

Apparently Palaz, in copying Meyer's table, did not give sufficient attention to having the ratios right, and therefore, the table gives, for the most part, the reciprocals of the proper values; *e. g.*, Palaz gives $\frac{\text{Sunlight}}{\text{Gaslight}} = 4.07$ at the "B" line, whereas Meyer gives $\frac{\text{Gaslight}}{\text{Sunlight}} = 4.07$.

The result is that the entire table is a mistake, through which he attributes a large amount of blue rays to incandescent lamps, and it is surprising that Dr. Birchmore did not compare such startling results with the work of others, for to a worker along these lines the error is apparent.

In aiming to improve our light sources we should indeed take sunshine as the ideal and normal light, but the combined work of Schumann, Meyer, Vierordt, Nichols, Franklin, and others, shows that our artificial sources are weak, not strong, in violet rays, and they are strong, not weak, in red rays; there is, therefore, no mistaken ideal in attempting to get higher percentages of blue rays in our artificial lights, for we need them.

Had this mistaken table been quoted by one writer alone, it would hardly have been necessary to call attention to it, but, again, and more recently,[2] it has been made use of by Mr. M. A. Edson in an article on "Vacuum Tube Lighting."

In the context of this table (which is transformed into percentages) he says: "As is well known, violet light should be avoided."

How has this become "well known," when it is in direct variance with the results of all workers who have studied the matter thoroughly?

It is true that a violet light is to be avoided, just as a red light or a green light is to be avoided, but a light with its proper proportions of violet light, as determined by our natural illuminant—the sun—is to be desired, and not avoided. The light from vacuum tubes often has a preponderance of violet and ultra-violet rays, but this is not always the case, for a tube containing traces of hydrogen gives a bright red light, one containing nitrogen a purple light, and so on. It is probable that if vacuum tubes were filled with proper proportions of several different gases, before exhaustion, that the remaining traces of the gases would give to the light the proper proportions of all rays from red to violet.

I am sorry to have to speak so critically of the two articles above cited, but it is time that our inventors and engineers were helped by the investigations of physicists, who have studied the subject, and were not misled and confused by articles that, were the tables on which they are based corrected, would disprove just what the writers attempt to prove.

The following curves give the results obtained by Nichols and Franklin[3] and by Schumann[4] in extended studies of the incandescent lamp.

Their results are in good accord with those of other investigators, and may be considered typical.

Fig. 1 shows the proportion of colored rays in different sources of light; the light from a 16-cp Edison lamp (operating at normal candle-power) being taken as a standard of comparison, and all of the sources being made equal to unity in the yellow region of the spectrum (at the "D" line). It is obviously necessary to reduce the intensity of the light from different sources to unity at some point (*e. g.*, the "D" line), since we are only concerned with proportions of colors, and could make no measurements that would mean anything by comparing the total brightness from sources, such as the sun and any artificial light.

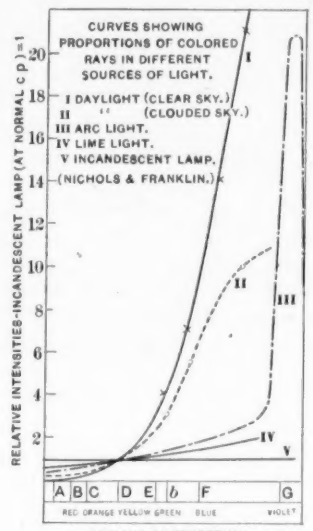

CURVES SHOWING PROPORTIONS OF COLORED RAYS IN DIFFERENT SOURCES OF LIGHT.
(NICHOLS & FRANKLIN.)
I DAYLIGHT (CLEAR SKY.)
II " (CLOUDED SKY.)
III ARC LIGHT.
IV LIME LIGHT.
V INCANDESCENT LAMP.
RELATIVE INTENSITIES-INCANDESCENT LAMP (AT NORMAL c p.)=1
A B C D E b F G
RED ORANGE YELLOW GREEN BLUE VIOLET
REGIONS OF SPECTRUM.

FIG. 1.

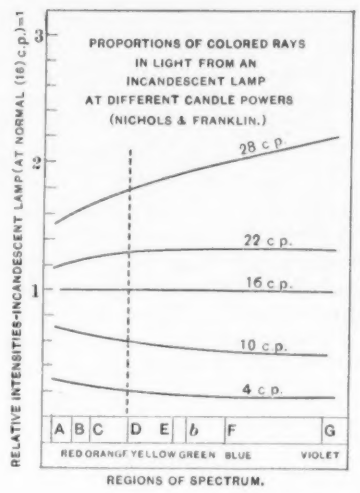

PROPORTIONS OF COLORED RAYS IN LIGHT FROM AN INCANDESCENT LAMP AT DIFFERENT CANDLE POWERS
(NICHOLS & FRANKLIN.)
28 c p.
22 c p.
16 c p.
10 c p.
4 c p.
RELATIVE INTENSITIES-INCANDESCENT LAMP (AT NORMAL (16) c.p.)=1
A B C D E b F G
RED ORANGE YELLOW GREEN BLUE VIOLET
REGIONS OF SPECTRUM.

FIG. 2.

Fig. 1 is the curve for daylight, when the sky is clear, and it shows in a most marked manner how very intense the blue end of the spectrum is in comparison with the incandescent lamp (V.), and with other artificial sources, such as the arc light (III.) and lime light (IV.); although in the case of the arc light there is one region, in the violet, where the radiation is unusually intense.

Curve II. in Fig. 1 shows that, with a clouded sky, daylight is not so predominatingly strong in blue rays, although it still shows itself much stronger than most artificial sources. Were curves for petroleum and gas plotted on Fig. 1, they would be a little above Curve V., at the red end of the spectrum, and somewhat below it at the violet end.

Fig. 2 shows curves for a 16-cp Edison lamp, operated at the abnormally high candle-powers of 22 and 28, and at the abnormally low candle-powers of 10 and 4. It will be noted at the red end of the spectrum the intensity increases more slowly than candle-power, and at the violet end the intensity increases more rapidly than candle-power. There is an intermediate region in which the intensity is proportional to candle-power, and the dotted line in the figure shows at what position this holds true; it is in the yellow, very near the "D" line.

It is to be hoped that in considering Fig. 1 no confusion with luminosity will arise. The curves of Fig. 1 simply give comparative values for the intensities of different sources in different regions

[1] Beibl. zu Wied. Ann., 1880, p. 130.
[2] *Western Electrician*, March 6, 1897.
[3] *Electrotechnische Zeitschrift*, May, 1884.
[4] Proc. Amer. Assoc. for the Adv. of Sci., August, 1888.

of the spectrum, when these sources are compared with a 16-cp lamp, and when the intensities at the "D" line have previously been made equal; *e. g.* Curve I. shows that sunlight, in the blue region, is proportionately twenty times brighter than the light from the incandescent lamp in the same region, and so on, but it tells nothing of the luminosity of a single source for any region of the spectrum, and it gives no comparisons of luminosities for different sources.

Information of this kind can only be obtained from such a curve as that shown in Fig. 3, which is the luminosity curve of an incandescent lamp at normal activity. This curve shows to what extent

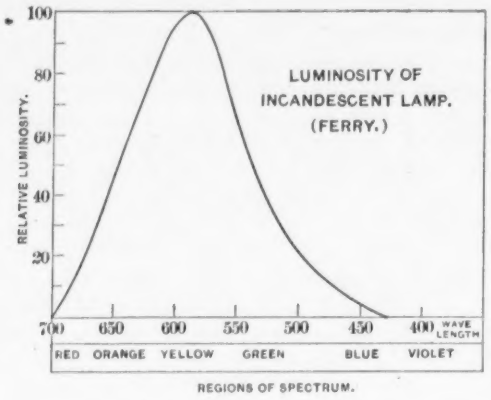


Fig 3.

the different colored rays, making up its light, contribute to the light-giving power of the source.

Luminosity curves may be plotted in several ways, but the most usual one is to hold a book (one that necessitates reading, not inference, such as a table of logarithms) in the different parts of the spectrum, and regulate the intensity of the light until one is just able to read the print at a fixed distance. Holding the book first in the red, then in the orange, and so on, the light will, in general, be decreased until the yellow is passed, when it will have to be increased as we approach and enter the green, blue and violet. The inverse of the values thus obtained for intensity of the source, when different parts of the spectrum are considered, are then plotted as ordinates (the maximum luminosity being called equal to 100) and the regions of the spectrum are made the abscissae.

This curve of Fig. 3 is similar in form to curves for most other

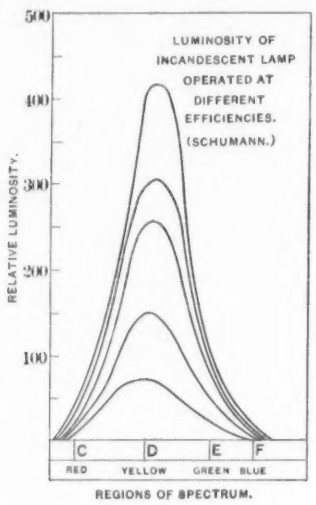


Fig. 4.

sources of light having a complete spectrum, but it is, of course, not identical with these, and for the incandescent lamp itself the luminosity curve changes in magnitude and form as the watts per candle change. (See Fig. 4, from Otto Schumann's results.)

The lowest of these curves is that for a lamp operated at a low efficiency, and the highest of them is for the same lamp at a much higher efficiency.

Luminosity curves of all sources, that emit a complete spectrum from red to violet, must be similar in general form, from the very nature of our organ of vision, with its limitations beyond both ends of the visible spectrum.

An examination of these curves shows that one ought to manufacture yellow light in order to obtain maximum efficiency, for yellow light gives a maximum return for the energy expended, but at the same time it is obviously necessary, for the health of our eyes, to have a light with the proper proportions of all rays in it, and no one, for instance, would advocate the use of the sodium light by which to read.

"The most important wave lengths, so far as light-giving power is concerned, are those which form the yellow of the spectrum, and the relative luminosity falls off rapidly both toward the red and the violet. The longer waves have, however, much more influence upon the candle-power than the more refrangible rays, as will be seen by an inspection of the curves (Fig. 4), the relative falling off of the red end of the spectrum being compensated by larger and larger accessions in the blue and violet as the state of incandescence increases.

"Luminosity is the factor which we must take into account in seeking a complete expression for the efficiency of any source of illumination, and the method to be pursued in the determination of luminosity must depend upon the use to which the light is applied. If we estimate light by its power of bringing out the colors of natural objects, the value which we place upon the blue and violet rays must be very different from that which would be ascribed to them, if we consider merely their power of illumination as applied to black and white. In a picture gallery, for instance, or upon the stage, the value of an illuminant increases with the temperature of the incandescent material out of all proportion to the candle-power, whereas, candle-power affords an excellent measure of the light to be used in a reading room."

It is not my object to go further into this subject at present. This paper simply strives to correct a mistake which already has become far too widespread, and if it serves to make matters at all clearer regarding both the composition of the light from different sources and the meaning of the term "luminosity" it will have served its end.

Detroit Meeting of the American Association for the Advancement of Science.

Among those who have expressed their intention to be present at the Detroit meeting of the American Association for the Advancement of Science, August 9 to 14 next, and participate in the proceedings of the Physics Section, are Prof. A. G. Greenhill, of Woolwich; Prof. J. V. Jones, Cardiff, and Profs. John Perry and W. E. Ayrton, of London. It is expected that many electricians will be present. Those who wish to attend the meeting and are not members of the association should correspond with Prof. F. W. Putnam, Salem, Mass., the permanent secretary of the association, or with Dr. Frederick Bedell, Ithaca, N. Y., the secretary of the Physics Section.

Volunteer Corps of Electrical Engineers.

To the Editor of The Electrical World:

Sir—In your issue of June 26 you call attention to the fact that a corps of military electrical engineers has been organized in England as part of the volunteer force, and deprecate that such an idea had not been first suggested in this country. This idea was discussed several years ago, when the late Gen. Josiah Porter was Adjutant-General of the State of New York. It was then considered best to develop an existing organization of the National Guard into a body of military electricians, and a signal corps was so selected. The regulations were then modified so as to restrict enlistments to men who are telegraph operators, electricians and engineers, and to-day the four divisions into which the signal corps is divided contain many men of high standing in the scientific professions. The State has been most liberal in providing scientific apparatus, and the reports of inspector-generals invariably comment on the high efficiency of the organization. The entire signal corps consists of about 200 men, divided into four corps, each of which is attached to a brigade headquarters, and is commanded by a captain who is assisted by a lieutenant and an assistant surgeon. Each brigade corps is mounted, and on ordinary occasions acts as escort to the brigade commander.

Edward B. Ives,
Major and Chief Signal Officer,
National Guard of New York.

New York City.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Dynamos.—Lond. *Elec. Rev.*, June 25.—An editorial discussion of Mordey's recent paper. While the new winding may be an improvement, it is thought doubtful that it will accomplish all that is claimed for it by the inventor; the test referred to in the paper was made with a bad dynamo, and how much the new winding would have improved a good dynamo is not certain; while the invention may not reduce the cost of dynamos very much it is thought certain that it will reduce the sparking difficulties and this may cheapen indirectly the first cost; the paper is well spoken of as being a valuable one.

LIGHTS AND LIGHTING.

Stage Lighting. BAEHR. *Elek Zeit*, June 17.—A brief abstract of a recent paper in which he described the various apparatus which he has been using during the past 30 years, and by means of which various light effects are obtained on the stage, chiefly for the imitation of sun and moon light.

Electrical Illuminations at the Queen's Jubilee.—Lond. *Elec.*, June 25.—A brief description.

Slotted Arc Carbons.—Elec. Eng, June 30.—An illustrated description of a carbon invented by Foote in which there is a longitudinal slot running into the centre, like a longitudinal sawcut half through the carbon; the object is to prevent the arc from traveling around the circumference of the carbon; the usual shadows are therefore not formed.

POWER.

Local Distribution in Workshops. SCOTT Lond. *Elec Eng.*, June 25.—The conclusion of his long serial, the installments of which have all been noticed in these columns. He gives a long table summarizing the advantages and disadvantages of continuous and alternating currents for workshop distribution, and believes that the general conclusion which one must come to is that the best service will be obtained from continuous currents, especially where lighting, power work, both variable and at constant speed, welding, traction, electrolytic work and charging accumulators are to be used; there is advantage in having only one type of generating plant. In conclusion he gives a long list of recently published papers on this subject and their references.

Transmission in a Colliery.—Lond. *Elec. Rev.*, June 25.—An abstract from the London *Engineer* of a recent paper by GORCHOT read before the French Society of Civil Engineers and describing an installation at a colliery raising 5200 tons daily, the power being furnished from "dirt and shale separated in the washing and screening," this being used to produce gas; there will be 10 dynamos in the form of three-phase alternators; coal-cutting machines are also used.

Electrically Driven Plowing Tackle.—Lond. *Eng'ing*, June 18.—A well-illustrated description of the machinery constructed by Borsig, of Berlin, and now used in many localities in Germany; with such a system it is now possible at small cost to use electric plowing over a large area. Each set includes a motor wagon containing the machinery, an anchor wagon on the opposite side of the field serving merely to hold a pulley over which the cable passes, and a movable plow which is drawn backward and forward by means of the cable operated by the motor; the plow cuts five parallel furrows at a time. The motor wagon carries a 40-hp alternating current motor; with an electric conductor of 1640 feet and a plowing rope of 985 feet it is possible to plow 220 acres from one centre of operation; where electric power is not available he uses a portable steam engine to operate the cable. The weight of the motor wagon is seven tons. The only figures regarding cost are that with a fixed steam engine at 250 horse-power and five plows, 6000 acres of medium heavy ground can be plowed to a depth of 14 inches at a cost of 85 cents per acre; whereas if separate engines are used the cost per acre will be increased by 14 cents.

Charging Open Hearth Furnaces. HEAD. Lond. *Elec.*, June 25.—A long abstract, with illustrations, of his recent paper, which has been noticed several times in these columns, and in which he describes the Wellman charging machine (American), which is operated by an electric motor.

Mining Pump.—Lond. *Elec.*, June 25.—An illustrated description of the electric mining pump in use at the Blanzy mines in France; it is rated at 60 horse power.

Printing Establishment.—West. Elec., July 3.—An illustrated description of the plant of the Lakeside Press, which is claimed to be the most complete electrically operated printing house in the West; the generator is a 100 kw dynamo; there are 35 individual motors, besides two elevators.

Electricity in the Modern Machine Shop. BELL. *Eng. Mag.*, July.—A continuation of his serial. He discusses the cost reduction and labor saving by electric applications. He shows how the use of electric power has proved to be an important element in labor economy and then describes, with the aid of illustrations, a number of tools operated electrically; also a soldering iron, heating implements, etc; the portable devices afford the most direct method of lessening the labor cost.

Future Possibilities of Electricity. PERRINE. *Elec. Eng'ing*, July 1.—A reprint of a lecture delivered in San Francisco; he discusses only those possible applications due to the transmission of large amounts of power as are of importance on the Pacific Coast, where power from steam is not readily available but where there is abundance of water power. He shows how mechanical power may thus be made available for working mines and delivering power to manufacturers; that new methods of chemical decomposition and synthesis are made possible, and how heat generated electrically may be used to advantage for smelting.

TRACTION.

Alternating-Current Accumulator Traction. DERI system. *Zeit. fuer Elek.*, June 15.—A long description of an odd and somewhat ingenious system which it appears has not yet been tried in practice although some experiments have been made and it is stated that it is to be used in practice in a very short time. He uses high tension alternating currents, single or multiphase, and converts them by stationary transformers at any desired number of places, into low voltage alternating currents, which are then transmitted along the trolley wire to the car; it is therefore adapted to long distances and requires no rotary transformers; the trolley line extends only along convenient stretches, there being none at all at crossings, switches, stations, etc. The car contains an equal number of alternating and continuous current motors, say two or one of each; the alternating current motors are supplied from the trolley wire, while the continuous current motors are run from a battery of accumulators carried by the car; there is no electrical connection whatsoever between the two currents, the two motors being merely connected mechanically; at normal speeds the car is run by the alternating current motors and during that time the continuous current motors are charging the batteries; when the car starts or when the speed is below that corresponding to synchronism, the car is run from the accumulators; instead of braking the car the energy is stored in the accumulators; in mounting steep grades both the continuous and the alternating current motors are used for propelling. There is no difficulty in this system in having an overhead return, that is, no contact with the rails, as all switches and crossings of the trolley wire are avoided. By this method quite a number of the difficulties encountered in the ordinary system are claimed to be overcome; some new ones, however, arise, such as guiding the trolley across a break in the trolley wire; these are discussed and enumerated in detail. The lowest note audible to the human ear corresponds to a frequency of 10, and if the alternating current is made to have as low a frequency as this, the inductive action on telephone lines will no longer be audible; for motors and incandescent lamps such a low frequency is not objectionable. The combined power of the motors need not be greater than in the present system (this is open to question); in general the two kinds of motors should develop an equal power; the continuous current motors should be excited in shunt as the regulation then becomes simple and economical; the wires are variously grouped at starting thus economizing energy; by regulating the excitation, the continuous current may be made to charge or discharge the battery and this method is used also in place of the brake; the alternating motors are connected to the circuit only when the speed is near that of synchronism, and it is well-known that they will synchronize when slightly above or below the desired speed; the cutting in of the alternating motors and the regulation of the excitation of the continuous motors, is accomplished by means of an automatic regulator operated by the line current, its function being to regulate the resistance in the shunt circuit of the continuous current motors; this regulator therefore performs a number of the operations automatically. The controller is even less complicated than for the ordinary systems as the automatic regulator performs a number of its functions.

Motor Cars.—Lond. *Elec. Rev.*, June 25.—An abstract of the recent discussion in the London *Engineer*, which paper claims that there is no motor-car industry in England, a statement which has called forth protest.

Inclined Plane Elevator.—L'Eclairage Elec., June 19.—A note stating that at the large department store in Paris called Magasins du Louvre an inclined plane elevator has just been put in operation; it appears to be similar to the one illustrated in the American journals not long ago; the speed is 30 cm per second; the passengers are made to dismount by having the top of the movable inclined platform slightly above the stationary platform; a 14-hp motor is used.

Behr Monorail System.—Lond. *Eng'ing*, June 11 and 18.—An illustrated description of this system, which is to be one of the leading features at the Brussels international exhibition; an illustrated description of the same system was referred to in the *Digest*, June 5.

Brussels-Tervueren Railway.—L'Energie Elec., June 1.—A long, well-illustrated description of this railway, in which the Walker machinery is used largely; a feature of interest is that the trolley wire is not directly over the car, but that both wires for a double-track line are near together on the same bracket poles.

Trolley Line Construction Data.—Elec. Eng., June 30.—An extract from a catalogue on trolley poles, giving data and illustrations concerning the erection of the trolley poles and lines.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Lighting and Traction from the Same Station. Van Vloten. *L'Eclairage Elec.*, June 19.—An extract from a long report which he submitted at the International Tramways Union in Stockholm last year; the extract refers only to that portion discussing the advantages or otherwise of lighting stations furnishing currents for tramways and vice versa, taking the results obtained at Hamburg as an illustration. He concludes that, while lighting stations could profitably furnish currents to railways, railway power houses would not find it profitable to furnish current for lighting.

Systems of Charging for Electricity. Pink. Lond. *Elec.*, June 25.—A short communication in which he protests against some of the statements made by Wright in his recent (American) paper; he does not favor the use of the expensive demand indicator and claims that the same thing may be accomplished in a different way.

Large Isolated Plant. Lond. *Elec. Eng.*, *Elec. Rev.* and *Elec.*, June 25.—A brief description of the 1100 horse-power plant, with a capacity of 20,000 lamps, at the Blackpool Winter Garden.

Chicago Edison Station. Lomas and Gunton. Lond. *Elec. Rev.*, June 25.—A long well-illustrated description.

WIRES, WIRING AND CONDUITS.

Electric Wires in Powder Magazines. Violle. *L'Elec.*, June 19.—A reprint of a brief report made to the Academy by its request, concerning the installation of electric wires in and about powder magazines. It is claimed that there is no need of making any distinction between telegraph, telephone, light or power wires which are exposed to the action of lighting; a distance of 10 metres is sufficient for all wires; the same distance should be preserved between water and gas pipes and the powder magazines; a distance of 20 meters is recommended for overhead wires; the safest way of lighting the interior of the magazines is by means of incandescent lamps; all the keys, switches and fuses should be placed outside of the magazines; only low-tension currents should be used, that is, not exceeding 110 volts; no movable lamps should be used and each lamp should be protected with an additional glass globe; electric bell wires should be kept at a distance of four meters; overhead lines should be provided with lightning arresters. This report was adopted by the Academy.

Insulated Pipe Wiring.—Lond. *Elec. Rev.*, June 25.—A short anonymous communication criticising the recent discussion in that journal. It is thought that before insulating tubing can become a standard article some one should show from actual experience that plain tubing carefully used is really as unsatisfactory as the advocates of the lined pipe claim; during the past eight years he has installed several hundreds of thousands of feet of uninsulated pipe, and has never had the slightest trouble from condensation, and he therefore does not see why insulated pipe should be resorted to.

Calculation of Lighting Circuits for the Three-Phase System. Cahen. *Elek. Zeit.*, June 3 and 10.—A long article in which he gives a simple analytical and graphical discussion of the calculation of such lines; a long abstract will be found in another column of the present issue.

Conduit. Dunlap. *Elec. Eng.*, June 30.—A short description of the Cummings conduit used under the asphalt pavement in a street in Niagara Falls; it consists of an iron pipe containing five ducts made of well-dried wood, the spaces between the ducts and the pipe being filled with an insulating compound.

Wiring and Wiremen. Sharpsteen. *Elec. Eng.*, June 30.—The first part of an article in which he claims that too little has been written about the work of the wiremen, and that the wiring business does not get the consideration which it should; much very poor work has been done; one great fault is that architects, engineers and inspectors have not the proper knowledge of the work; he believes that the wiring work in the average buildings is not safe. He begins the description of the wiring of a dwelling with reasons why he does certain things differently from the usual custom.

ELECTRO-PHYSICS AND MAGNETISM.

Simultaneous Production of X-Rays and Light. Commelles. *L'Elec.*, June 19.—An abstract of a French Physical Society paper describing experiments with a double bulb having a tubular connection between the two parts, and each a cathode; he showed that the internal pressure was not the same at all points, the molecules being forced with great violence toward the extreme end of the apparatus; various results were obtained when the cathodes and anodes were connected in different ways, tending to show that different pressures existed in the two tubes. In the discussion Villard did not think it was correct to deduce the conclusion regarding the distribution of the material in the tube; the fall of voltage is almost entirely at the cathode end connecting with the coil.

Properties of Simple Cathode Rays. Deslandres. *L'Eclairage Elec.*, June 19.—The unobstructed cathode rays are propagated in straight lines and their properties are identical; if, however, a conductor is in their path and is connected to earth or to the negative pole, the cathode rays will be bent unequally, analogously to the light spectrum; these bent cathode rays he calls simple rays, as they appear to have the same importance which the simple rays of light have to the composite white light waves; he studied these bent rays; the spectrum which he obtained was 14 mm in length; the spectrums from a number of different metals were found to be the same, but the intensities were different, aluminum giving the most intense result; he found by using as a source one giving simple electrical oscillations, like the Tesla apparatus, that what he calls the simple cathode rays correspond to simple electrical oscillations.

Röntgen Rays.—Lond. *Elec. Rev.*, June 25.—Brief references to exhibitions at the Royal Society Conversazione. Macintyre exhibited a very powerful apparatus; the current was interrupted by a longitudinal movement imparted by an eccentric operated by a high speed motor; he obtains photographs of the chest in 10 seconds and has even succeeded in reproducing cinematographic ribbons showing the movements of the skeleton of a frog. S. P. Thompson showed among other things an experiment in which the rays from a flat cathode were directed onto a metal gauze screen; before passing through the screen the rays were green and could be deflected by a magnet, while after they passed through they were blue and could not be deflected.

Recent Röntgen Ray Progress.—Lond. *Elec. Rev.*, June 25.—A summary of recent progress, most of which refers to American work. A paper by Voller and Walter from the *Wied. Ann.*, May, p. 88, is referred to; they obtain the exact penetrative power for different kinds of work by the method, already noticed, of placing caustic alkali in a small communicating tube and heating it by means of an electric current; it then becomes necessary to connect the anode to earth to prevent sparking to the heating spiral. They also made experiments of the relative decrease of diffused deflection possessed by different elementary substances; these are mentioned in the abstract.

Improvement in Crookes Tubes. Villard. *L'Eclairage Elec.*, June 19.—An abstract of a French Physical Society paper pointing out several improvements; one is to use pure iridium for the anti-cathode, as it will stand the heat better and will not blacken the bulbs; a tube may be regenerated when its resistance is too high by means of an auxiliary electrode, for which magnesium answers the purpose very well; when it is made the cathode it disengages a gas and when made an anode it absorbs it again; the resistance of a tube may be varied by the use of two cathodes, the first of which is directly connected to the coil; if it is touched with a piece of meta a spark will pass between it and the second cathode and the resistance of the tube will thereby be lowered.

Action of X-Rays on the Epidermis. Destot. *L'Eclairage Elec.*, June 19.—An abstract of an Academy paper. After studying the effect he concludes that it is the electric wave and its form which is the cause of the trouble and not the X-rays themselves.

Oscillations by Resonance. Planck. Lond. *Elec.*, June 25; abstracted briefly from the *Wied. Ann.*, 60, p. 577. The energy received in a resonator is converted partly into oscillations and partly into heat; these two forms are essentially different and to neglect the oscillating form leads to serious errors; as the frequency increases the damping becomes less, and the transformation into oscillations is the chief disposal of the energy; in the paper he investigates the theory of this damping and gives the results in a complete mathematical form.

Oscillating Charges. Seiler. Lond. *Elec.*, June 25, abstracted briefly from the *Wied. Ann.*, 60, p. 30.—He extended the range of previous observations and obtained oscillations in the charges of a condenser, having a perfectly sinuosidal character; the method may be used to advantage for the measurements of self-inductions.

Variable Impedance. Petrovitch. Lond. *Elec.*, June 25; noticed briefly from the *Jour. de Physique*, May.—He studied the case in which the capacity, resistance and self-induction vary in any assigned way, and he arrives at a new equation which is said to be remarkably simple and is given in the abstract.

Capacity and Residual Charge of Dielectrics. Hopkinson and Wilson. Lond. *Elec. Rev.*, June 25.—The conclusion of the reprint of their long paper. No general conclusions are drawn.

Mercury Arc. GUMLICH. Lond. *Elec.*, June 25.—A brief abstract, with the illustration, of his recent article on the Arons lamp in which the arc is produced in a tube between cadmium amalgam electrodes (see also *Digest*, June 26).

Physical Theories During the Past 60 Years.—Lond. *Elec*, June 25.—An interesting summary for the past 60 years; the larger portion refers to electricity and magnetism, and is interesting reading.

Magnetization of Iron and Steel in Weak Fields.—Elek. Zeit, June 17; a brief abstract of a report of the Reichsanstalt in the *Zeit. f. Instrumentenkunde*, May.—Different samples of iron and steel were examined; the magnetization coefficient for all the four steel samples was a straight line up to a field strength of 2.5, and it had only a very slight inclination toward the axis of abscissas, that is, the coefficient increased only very slowly; the beginning of the line was at eight to nine C. G. S. units; with hardened steel this coefficient was about one-fourth and the line was also straight; soft as well as hard wrought iron did not show such a simple relation; the results are given in the Proceedings of the Berlin Academy.

Action of Solenoids on Cores.—Elec. Eng., June 30.—A diagram giving, in the form of curves, the results of a large number of experiments under various conditions, the ordinates representing ounces of force exerted on the plunger and abscissas the distance that the end of the plunger has entered the coil.

ELECTRO-CHEMISTRY AND BATTERIES.

Extraction of Gold from Cyanide Solutions. CREASDALE. Lond. *Elec. Rev.*, June 25.—The conclusions arrived at from a large number of experiments conducted on a commercial scale. The most advantageous method was the electrolytic precipitation using amalgamated zinc plates for the positive and sheet lead for the negative electrodes; the current strength was 0.04 to 0.05 ampere per square foot of depositing surface; each square foot received the gold from half a pound of solution in 30 seconds; in three experiments the gold extraction was from 95.5 to 99.6 per cent, and this could be obtained continually. The solution, as it came from the precipitating tanks, was remarkably active in dissolving gold, due, it is thought, to nascent oxygen, and the action was fully as great as that produced by the addition of sodium peroxide.

Effect of Time on the Nature of the Copper Deposit. ULLMANN. *Zeit. f. Elektrochemie*, June 5.—In depositing copper there are certain conditions under which the deposit will be dark and spongy; this takes place under otherwise the same conditions, after a certain lapse of time; he points out the importance of this factor of time, and in order to investigate it he made a number of experiments which are described and the results of which are given; he used horizontal electrodes and carefully kept the other conditions the same; the exact time when the deposit began being black was almost identical with a sudden rise in voltage. Among his conclusions he finds that for the same solution and for different current strengths the product of the current strength and the square root of the time is approximately a constant.

Electrolysis of Salts and Bases. LOSANITCH and JOVITSCHITSCH. Lond. *Elec. Rev.*, June 25.—A brief abstract from a recent paper; when alkaline salts are electrolyzed in the presence of ammonia hydrogen is set free at the cathode and nitrogen at the anode, but the latter is relatively small; they investigated the cause of this irregularity; they believe that hypochlorite is formed; in certain cases part of the oxygen is set free, while the rest forms nitrites and sets free nitrogen.

Electro-Metallurgy of Zinc.—Lond. *Elec. Rev.*, June 25.—A brief description of a new process (but the name of the inventor is not given). The chief feature is the ammoniacal bath; the thoroughly oxidized ores are ground and treated with a concentrated solution of the carbonate, sesquicarbonate or the bicarbonate of ammonium, or a mixture of them; the bath is covered with a layer of mineral oil to prevent loss of ammonia; the solution is freed from iron by hydrated oxide of tin; the copper is recovered by plates of zinc; the solution is then electrolyzed between zinc cathodes and tin or lead anodes.

Electrolytic Iron. HOULLEVIGUE. Lond. *Elec.*, June 25; noticed briefly from the *Jour. de Physique*, May.—He investigated the properties of electrolytic iron and finds they are dependent on the composition of the electrolyte and the current density, which influence the amount of hydrogen contained in the deposit; with a bath rich in sal ammoniac and a current density of about 0.04 amperes per square centimeter, the iron deposit obtained will contain about 0.145 per cent. of hydrogen; its resistance was obtained with some difficulty. (See also *Digest*, June 19.)

Production of Uranium. MOISSAN. Lond. *Elec. Rev.*, June 25.—He obtains the material by heating the oxide with sugar carbon in the electric furnace; under certain conditions, which must be carefully carried out, the metal can be prepared free from carbon.

Applications of Electro-chemistry to Organic Chemistry. ELBS. *L'Elec.*, June 19.—An abstract from a recent German paper giving a brief summary of researches which have been made in this direction, and offering an explanation of those referring to the electrolysis of acetate of sodium producing hydrogen, the carbonic hydrates and anthone at the anode.

Manufacture of Chlorate of Potash. KERSHAW. Lond. *Lightning*, June 17.—An article in which he describes the general principles of the three processes which are used on an industrial scale, giving the current and energy efficiencies and the cost of manufacture. He claims that the manufacture of caustic soda by the electrolytic method has not achieved a marked success, but the production of chlorate of potash has a most successful future before it; it is estimated that three-eighths of the total product is now supplied by the electrolytic process and that it is only a question of time before the older chemical process will be entirely replaced by it; a table of a number of factories is given, with their outputs, as far as ascertainable. (Much of the information seems to be the same as that in his previous series of articles, which were fully noticed in these columns.)

Conductivity of Electrolytes.—Elek. Zeit., June 17; a brief abstract of a report of the Reichsanstalt, from the *Zeit. f. Instrumentenkunde*, May.—The conductivities of electrolytes at present used are those determined by Kohlrausch and Grotrian in 1874; it is therefore necessary to reduce the constants to the new units of resistance and temperature; as far as could be ascertained from several researches the reduction factor would be about 1.069.

Theory of the Accumulator. FOERSTER. *Zeit. f. Elektrochemie*, June 5.—An article in which he reviews briefly some of the numerous theories suggested by others with special reference to the hypothesis that lead ions with four equivalents are produced and describes experiments which show that such ions may be produced; he shows that Le Blanc's explanation of the process at the anode is in good agreement with facts; in explaining the action of the accumulators the electrolysis of the lead solution should not be the only thing to be considered.

Van t' Hoff's Constant. WILDERMAN. Lond. *Elec. Eng*, June 25.—A brief extract from the Proceedings of the Chemical Society describing his experimental verification of this constant in very dilute substances.

Iron Smelting. DE LAVAL. *Elec. Eng*, June 30.—An illustrated description from a recent United States patent which it is thought may be the one referred to in recent notices that large plants were to be erected in Sweden for reducing iron of great purity from the ores; the present description, however, refers merely to the furnace for melting metallic iron. It appears that the current is passed through a sort of inverted U-shaped channel having iron electrodes at the lower portions, the current going up on one side through the material and down through the other electrode (it, therefore, is not an arc system); as the iron is melted it runs off, thus making the process continuous; the method may be used to overheat a metal; an electrolyte of melted magnetic iron ore may be used as a bath.

Improved Elmore Process.—Eng. & Min. Jour., June 26.—A short editorial stating that the well-known Elmore process, which has been tried in England for a number of years, has failed, but that a Frenchman named Secretan has made improvements by which these defects have been overcome, the copper tubes being made directly by electrolysis to meet the requirements for strength and being free from the tendency to separate into layers; they may be made of any desired thickness; such cylinders are afterward cut by metal saws into spiral strips which are drawn into wire, thus avoiding the work of preparing wire bars; these improvements are not patented, but are apparently kept a secret; they are said to be chiefly mechanical improvements and also an addition to the solution. A similar process was described by Thofehrn in that journal September 19, 1885, and it is thought it may be similar to the Secretan process.

Ashcroft Process.—Eng. & Min. Jour., June 26.—A statement that a very large plant for treating the zinc-lead sulphides in the Broken Hills Mines, Australia, by this process was erected; but it appears that the first practical operations have been a failure and have shown that the process has not overcome the objections.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Silver Voltameter.—Elek. Zeit., June 17; a short abstract from a report of the Reichsanstalt, published in the *Zeit. f. Instrumentenkunde*, May.—As was already found in previous observations, the deposits from the same current strength, in repeated electrolysis of the same solution, were found to increase; this was examined by further tests and it was attributed to two causes; the weight at the cathode for the same density increases more rapidly the thicker the layer of silver on which the new deposit is formed; and that by subsequent electrolysis the solution takes a different form, from which a larger deposit is obtained; the experiments have not yet been concluded.

Silver Voltameter and the Clark Cell.—Elek. Zeit., June 17; a brief abstract from a report of the Reichsanstalt from the *Zeit f. Instrumentenkunde*, May.—The voltage of the Clark cell was measured with the aid of a silver voltameter, and assuming as usual that one ampere in one hour deposits 4.025 gr. of silver per hour, results were obtained which gave appreciably different figures; in order to agree with the figure 1.448 at zero, as was obtained with the Helmholtz electro-dynamometer, the constant for a silver voltameter for fresh solutions would have to be 1.1182, and for a solution which has been used 1.1193 mgr. per ampere per second.

Registering Volt Meter. ROCHER. *L'Eclairage Elec.*, June 19.—An illustrated description of the instrument used by the Edison Company of France; it is based on the principle of the electro-dynamometer but is so arranged that the whole available scale covers only the difference between 100 and 120 volts or any other range desired, that is, the zero point is not on the scale; each volt is represented by distances of more than 4 mm.

Artificial Lines. Vaschy. *L'Eclairage Elec.*, June 19.—A highly mathematical paper on artificial lines, such as those made to imitate a long submarine cable, having a certain capacity resistance and coefficient of self-induction and formed of a number of coils and condensers exerting no mutual induction on each other; he shows how to calculate the currents in these branch circuits.

Thomson Meter.—Zeit. f. Beleucht., June 20.—A long illustrated description with diagrams of this meter and the modifications for three-wire, five-wire and three-phase systems.

Measurement of Capacities. Armagnat. *L'Eclairage Elec.*, June 19.—A continuation of his long serial on measuring instruments.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Micro-Telephonic Transmitter.—L'Elec., June 19.—The beginning of a description of the new forms of apparatus which have recently been admitted on the French lines; the Guyomard and Roland apparatus is illustrated and described in the present portion; the chief novelty appears to consist in the carbons, which are rods, the ends of which are rounded and have both circular and longitudinal grooves cut into them; the object is to prevent the crackling noises so frequent with movable carbons.

Telegraphy without Wires. Lond. *Elec. Rev.*, June 25.—A reprint of a letter by Lodge from a London daily paper. He corrects the popular impression that Marconi has made a new and wonderful discovery; he, Lodge, showed essentially the same method in 1894; the apparatus was also substantially the same; the only important discovery in the matter was that of Herz in 1888.

Determining the Relative Positions of Several Cables in a Tank. Taylor. Lond. *Elec. Rev.*, June 25.—Some further remarks on the method described in the *Digest*, May 29, and replies to recent remarks in that journal.

Cables and Seismology Milne. Lond. *Elec. Rev.* and *Elec. Eng*, June 25.—A brief abstract of a recent paper before the Royal Geographical Society. He accounts for cable fractures by a kind of submarine landslide; he exhibited charts of actual soundings which showed that great changes of level occurred in the sea bottom during short periods of time; the object of the lecture was the inauguration of some universal system of seismological observatories; a full account of the lecture is promised in the first-named journal.

Speed of Cable Messages.—Lond. *Elec.*, June 25.—A list of the times it took to transmit the queen's message to various remote parts of the British empire.

Rapid Cable Laying. Snell. Lond. *Elec. Rev.*, June 25.—A further description, with illustrations, of his system.

Burke System of Cable Telegraphy.—Elec. Eng., June 23.—A description taken apparently from a patent specification; the signals at the receiving station are not caused by electrical impulses nor do they correspond with them, but they "are made by and result from the action of local mechanical means, which becomes operative only during the intervals between the passage of impulses over the line and after such line impulses have ceased."

Telephones.—Elec. Eng'ing, July 1.—A number of communications against the use of two independent telephone exchange systems in Sioux City. This is followed by a number of press and personal opinions on the Berliner decision. (This journal takes sides with the Bell telephone interests.)

Automatic Telegraphy. Delany. *Elec. Eng.*, June 23 and 30.—The first part of an article. He discusses the question of speed of transmission by the simple Morse and the Wheatstone automatic systems; published reports of speed tests are very unreliable; he considers that a fair value for the best speed, including punctuation, is 41 words per minute; while a receiving operator writing long hand cannot always write as fast, yet an expert typewriter can take down all from the fastest sender; the average speed of the simple Morse instrument he says is about 15 words per minute; polar duplex will average about 18 words per minute on each circuit and for the quadruplex Morse 60 words per minute, with eight first-class operators over the best wires and for distances not exceeding 500 miles; for the duplex Wheatstone 100 words per minute each way he considers a liberal allowance; under the most favorable circumstances 300 words per minute simplex and 400 duplex can be obtained from the Wheatstone automatic; the use of a repeater would probably affect these results about 10 per cent. In estimating the speed of various systems he shows that the interruptions in the working due to disarrangements should be taken into account; these interruptions are much more frequent with the duplex and still more with the quadruplex; he does not consider the introduction of dynamos and accumulators into telegraphy an unqualified advantage; it is thought that the polar duplex is preferable to the quadruplex; the Wheatstone automatic system seems to have reached a limit of speed about 12 years ago, and he believes there is a fundamental obstacle in the way of any further advance in speed owing to the rapid movements of the mechanical parts; greater speed can only come through a system using no electromagnets in the receivers. He then begins the description of his chemical automatic system, which has already been described in these columns.

MISCELLANEOUS.

Electric Furnace. Helbig System. *L'Eclairage Elec.*, June 19.—A brief description of a convenient form consisting merely of a hollow cylinder of carbon enclosed in a box to confine the heat and in which there is a window of mica; the material to be treated is placed in the inside of the tube and a current is passed through the rod itself; with a current of 250 amperes at 40 volts a cylinder of porcelain was fused in 6 minutes; the carbon cylinder is 50 cm long, 2 cm internal diameter, the walls being 0.5 cm thick.

Use of Glass. Marcillac. *L'Eclairage Elec.*, June 19.—He mentions some experiments made in France with bearings for machines, made of glass; they differ from those made in this country in that they were not made of the common glass but of the finest pieces of pure St. Gobain glass as is used in clocks; if the results turn out to be of interest they will be given subsequently. Another application of glass is referred to; at Marseilles glass tubes are made for use as underground conduits or for interior wiring, as in theatres and other places where combustible insulators should not be used; the price is sufficiently low that it is not important when the advantages are considered.

Undulatory Currents in Therapeutics. Meylan. *L'Elec.*, June 19.—He calls attention to the different effects of various forms of currents, with special reference to a combination of an alternating and direct current, which has lately been tried with some success; such currents may be obtained by a battery in series with an alternating current; they may, however, also be obtained from the d'Arsonval apparatus by connecting one end of the circuit to one of the brushes on the commutator of the continuous current machine, and the other end of the circuit to a sliding ring connected to one commutator bar; such a current he calls an undulating current; it has a sinusoidal form but is always either positive or negative, rising from zero to the maximum and the reverse. He then describes at length how to measure such currents; the maximum voltage will be that of the continuous current and the mean voltage will be half of this; a voltmeter will indicate this half reading; an electro dynamometer will theoretically give a reading equal to 0.62 E (E being the continuous current voltage between two brushes); by measuring the alternating and the undulating volts by means of the electro dynamometer the ratio will be 1.16. He gives the results obtained in a practical test, showing agreement with the theoretical results; if the voltage is sufficiently high that the polarizations of a voltameter may be excluded an effective current of a certain amount will, as far as disengagement of gas is concerned, be equal to only 0.806 times that value. He recommends having two scales on the d'Arsonval measuring instrument, giving the two different values; the readings, however, will depend somewhat on the dynamo which is used; such undulating currents have been applied during the past 18 months.

Welded Steel Barrels.—Lond. *Eng'ing*, June 11.—A brief description of the process used at Uxbridge, in which the Bernados process of arc welding is used; a full abstract is published in the *Eng. and Min. Jour.*, June 26.

Electrical Exhibition in Russia.—The European electrical journals announce that there is to be an international exhibition in St. Petersburg in the year 1899, under the auspices of the Electrical Society. After the exhibition it is intended to start a permanent electrical museum and testing laboratory.

Laboratory Electric Furnace.—Eng. and Min. Jour., June 26.—A reprint of the illustration, with a description, of the one described in the *Digest*, June 19.

Long-Distance Electrical Power Transmission.

A contract for the transmission of power of the river running through the Santa Ana Canyon to Los Angeles and Pasadena, Cal., a distance of 80 miles, has been concluded between the Southern California Power Company and the General Electric Company. The amount of power to be transmitted at first is 4000 horse-power. The station will be located in the Santa Ana Canyon, 12 miles from Redlands and about 80 miles from the towns in which the electric power will be utilized.

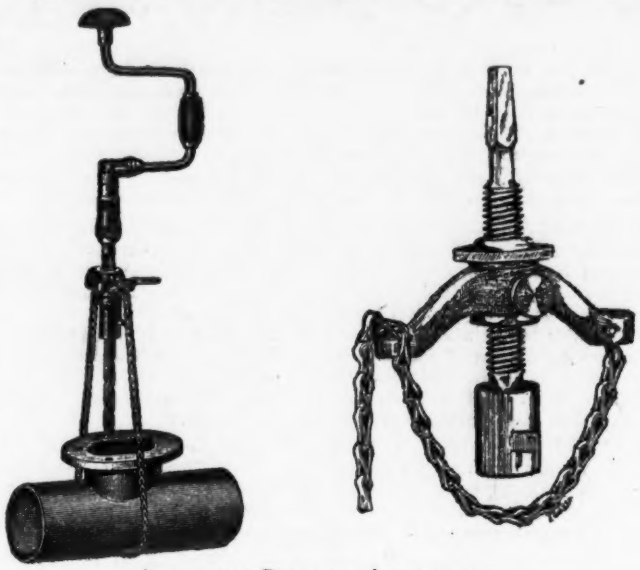
The water will be taken from the river through canal, flume and tunnel along the side of the canyon. Here it will be led into a pipe-line 2200 feet long, giving what will be equivalent to a vertical fall in the water of 750 feet.

The wheels will be of the impact type, directly connected to the generators, of which there will be four, each of 750-kw (1000-hp) capacity. The maximum line potential will be 33,000 volts, to which potential the initial voltage will be raised by twelve 250-kw step-up transformers.

This transmission, it is stated, will be the longest commercial electrical power transmission as yet undertaken, as well as that using the highest voltage. At present the longest is that transmitting the power of the waters of the Ogden Canyon, in Utah, to Salt Lake City, a distance of 36 miles. The Los Angeles transmission will be over twice that distance and three times the longest distance yet tried with the power of Niagara, which, to date, has only been transmitted to Buffalo, a distance of 26 miles.

Automatic Drilling Attachment.

The device illustrated herewith, it is evident at a glance, constitutes a very useful tool, and by its use much time and expense can be saved in drilling. It is claimed to more than double the efficiency and range of the breast drill, as it requires no pressure by the operator to make it cut. The chain does this part of the work. It is possible to drill holes up to three-quarters of an inch in diameter with ease and with no danger of springing the brace with a lever or other heavy pressure. In many cases it will take the place of the ratchet drill, and can be adjusted ready for use in one-tenth part of the time and in positions which no ratchet can reach. This tool will no doubt find a very large field of usefulness, especially by electrical manufacturing establishments, as it will bring the desired pressure to bear at

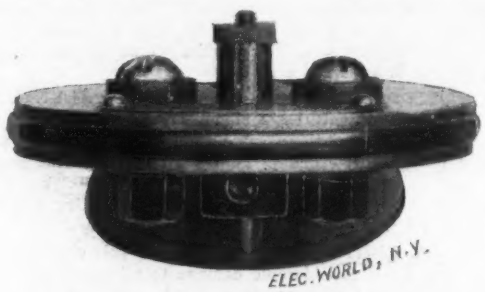


AUTOMATIC DRILLING ATTACHMENT.

points where ratchets and other drilling attachments cannot be brought to bear, as for instance, overhead on pipes and in awkward corners. It is made in a thorough manner and runs on ball bearings, reducing friction to the smallest possible amount, and is meant for shop and erecting gangs. Messrs. Albanus L. Smith & Co., Philadelphia, Pa., are the general managers and agents for this device, which is known as the Fifield automatic drilling attachment. It should be stated that it is self-feeding.

Protecting Device for Transformers.

One of the dangers in the use of transformers for electric lighting is the crossing of the primary and secondary circuits through faulty insulation, and that this does occasionally happen in spite of the most careful construction is well known. The Diamond Electric Company, Peoria, Ill., having become interested in the Cardew earthing device, on account of its simplicity and general reliability in action, has just started the manufacture of the same and expects to find a large field for the apparatus for use in connection with transformers. This device is said to be entirely new in this country, although it is extensively used in England, where over 5000 are installed. Its action depends on the electrostatic attraction between two plates of an aluminous foil. The lower plate is permanently kept at the potential of the earth, while the upper plate, under ordinary circumstances, is kept at a potential not exceeding the secondary voltage.



EARTHING DEVICE.

The electrostatic attraction corresponding to this potential difference is insufficient to raise the foil. If, however, a fault develops between the primary and secondary, the potential difference immediately rises to such an amount that the electrostatic attraction suffices to raise the foil and bring it into contact with the upper plate, thereby earthing the secondary winding and blowing the primary fuse. The apparatus is said to act if the potential of the secondary rises to 400 volts.

The illustration of the device, which is shown herewith, gives an excellent idea of its appearance, and the description of the same indicates that in construction it is remarkably simple.

A New Street Railway Motor.

The General Electric Company announces a new street railway motor of a capacity between its G. E. 1000 and 800 types. It is known as the G. E. 52, which classification is in accordance with the arbitrary nomenclature adopted by the company, the former nomenclature, derived from the draw-bar-pull, having been abandoned.

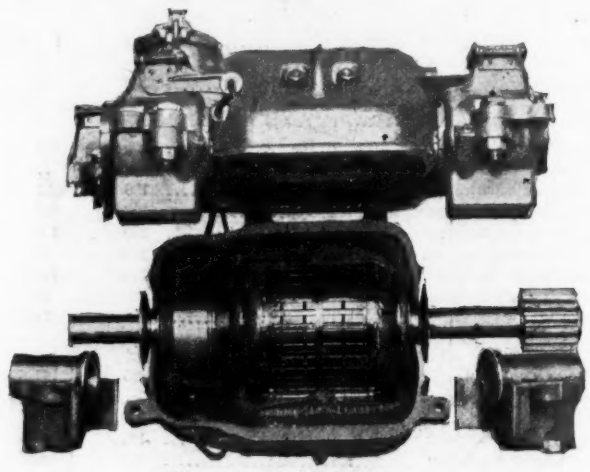
The design of this motor is along lines dictated by years of experience, and no pains have been spared to make it light in weight, compact in form and simple in construction, while retaining all the excellent features of the G. E. 1000 motor. It has an output of 28 horse-power, and is intended only for ordinary street-railway work. It will accommodate electric brakes; but as some additional capacity is required for brake service the company does not recommend this motor for such work except in purely street-railway service.

The frame is of steel, cast in two bowl-shaped pieces and hinged and bolted in such manner that the motor is practically water and dust proof. A hand hole, fitted with cover plate and gasket, is let into the lower half, directly beneath the commutator, permitting easy access to the bottom of the motor for inspection or for the removal of any foreign substance. The motor has four poles, each with its own coil. The pole pieces are laminated, but are bolted to the frame.

The large bearing surface of this motor is one of its most important features. The armature bearings are designed for the use of oil or grease, or both. The upper grease or oil cups are of ample size and are provided with wicks or wipers, which wipe the shafts through openings cut in the linings. The axle bearings are also fitted with two wipers to each bearing.

The field coils are wound with asbestos-covered wire and "mummified." Each is held in place on its respective pole by means of the pole-piece projections, supplemented by a spring steel plate, and is placed in position before the pole piece is bolted to the frame. For convenience in car wiring and opening for motors, the field connections between the upper and lower fields have been made on the outside of this motor, and both the field and armature leads are brought out at the front of the motor as in the G. E. 1000 motor.

The armature is of the well-known iron-clad hollow-core type, 11 inches in diameter, with a spread of 9 inches. The core is built up of well-annealed laminæ, and to increase the circulation of the air is provided with three ventilating ducts, as in the G. E. generator armatures. The armature has no spider, but it is assembled directly on the shaft. The small number of coils is of special advantage in the matter of armature repairs, while the method of forming them in groups of three admits of a substantial insulation of high quality.



MOTOR OF NEW DESIGN.

The standard gear ratio is 4.73. Higher speed gear ratios may be used, furnishing increased speed with proportionately decreased tractive effort.

The commutator segments are of hard-drawn copper, 1 13-16 inches deep, allowing a wearing depth of 1 inch. In assembling, clamping bolts have been dispensed with and the clamping ring is held in place by a ring nut.

The brush holders are standard, and staggered to prevent the wearing of ridges in the centre of the commutator, and the brush-holder yoke is carefully treated with an insulating compound and rubbed to an enamel finish, preventing the lodging of carbon dust.

The suspension can be either the nose, the yoke or the side bar. The yoke suspension is, however, especially recommended, as with it the weight of the motor is carried on springs placed upon the side frames of the car trucks. Lugs are cast on the upper half of the motor frame, to which the suspension bar is bolted, the motor being suspended from the top half. This permits easy access for inspection or repairs.

When the motor is mounted on 33-inch wheels, the clearance between the bottom of the motor and the top of the track rails is 5 7-8 inches. The clearance between the bottom of the gear case and the top of the track rail is 4 5-8 inches, a feature which railway men will appreciate.

The motor without gear or gear case weighs 1460 pounds; complete, with 67-tooth gear and malleable iron gear case, the weight is 1725 pounds.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, July 5, 1897.

ELECTRICAL STOCKS.—General Electric, both common and preferred, were the only securities showing any advance in quotations at the close of business last week. The rest of the list was either unchanged or lower. Edison Electric Illuminating declined ¼ point on total sales of 100 shares, and Electric Storage Battery is down 1½ points. The preferred stock of the same company receded about the same amount. General Electric common closed at a figure ½ point higher than the last quotation, the total sales for the week amounting to 18,181 shares. The preferred stock advanced 3 points. There was slight activity in consolidated bonds of the Edison Electric Illuminating Company, of New York.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	115	117
Edison Electric Ill., Brooklyn	100	107	108½
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill , Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	20	20½
Electric Storage, pref	100	22	23
General Electric	100	33⅞	34
General Electric, pref	100	..	77
Westinghouse Consolidated, com	50	21	23
Westinghouse Consolidated, pref	50	50	51
BONDS.			
Edison Electric Ill., New York, con. 5s	£ 105	112	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	99½
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	230	231
American District Telegraph	100	..	35
American Telegraph and Cable	100	91	93
Central and South American Telegraph	100	124	127
Commercial Cables	100	160	..
Erie Telephone	100	65	66
New England Telephone	100	104	101½
Postal Telegraph Cable	100	99	101
Western Union Telegraph	100	84¼	84½
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18⅜	18⅝
Brooklyn Rapid Transit	..	30½	31
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	68	70
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	40	43
Hestonville	100	50	51
Hestonville, pref	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	28	30
North Shore Traction	100	20	23
North Shore Traction, pref	100	80	82
Rochester Street Railway	..	10	11
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	..	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	84¼	85
West End, Boston, pref	100	91¼	92
Worcester Traction	100	14	16
Worcester Traction, pref	100	90	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	84	..
*Buffalo Street Railway 1st con. 5s	100	106½	108½
Cleveland Electric Railway 1st mtge., 5s	100	103	105
*Columbus Street Railway 1st 5s	100	94	96
Rochester Street Railway 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	105	107½
*Westchester Electric 1st mtge. 5s	100	100	108

*With accrued interest.

TELEGRAPH AND TELEPHONE.—There was general weakness in this class of stocks, and the closing quotations, with only one exception, are either unchanged or show losses. American Bell stands at the same figure as our last quotation and the other telephone stocks remain unchanged. The American Telegraph & Cable is 1 point lower and Commercial Cable 8 points. Postal Telegraph Cable receded 1 points, while Western Union advanced ¼ point. The total sales of the latter for the week were 35,321 shares.

ELECTRIC TRACTIONS.—Business in this class of securities seems to be practically at a standstill, the few changes in prices being merely fractional. Brooklyn Rapid Transit was about the only exception, and showed considerable strength at the close of the week, which was probably due to the reports regarding the proposed consolidation in Brooklyn. The quotations of this stock closed at a figure about 4 points higher than the previous quotation, and the number of shares sold during the week amounted to 55,991. In the railway bond list Brooklyn Rapid Transit 5's showed the same activity displayed in the stock, and advanced 3½ points, at which figure it closed the week. The sales during the week were 930 shares.

LARGE MORTGAGE.—The Cataract Power & Conduit Company, of Buffalo, N. Y., has given to the Metropolitan Trust Company, of New York, a mortgage on its property and effects for $2,000,000. The mortgage is to bear interest at 5 per cent., payable semi-annually, and is to become due and payable in the gold coin of the United States, not more than thirty years from June 29.

TO LIST ADDITIONAL BONDS.—The Edison Electric Illuminating Company of Brooklyn, has asked the New York Stock Exchange to list $250,000 additional first mortgage 5 per cent. gold bonds, making the total amount listed $1,500,000.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, July 8, 1897.

ELECTRICAL GOODS FOR SOUTH AMERICA.—The steamer "Galileo," which sailed a few days ago for Rio Janeiro, Brazil, had among her cargo 1358 packages of electrical material valued at $15,442, and $10,000 worth of machinery for small plants.

ASSIGNMENT OF A FIRM OF ELECTRICAL ENGINEERS.—On July 7, the firm of Fleming & Poillon, electrical engineers and contractors, at 39-41 Cortlandt Street, made an assignment to Mr. S. H. Halstead. The liabilities are set at $10,000, but no estimate of the assets is given. The firm was composed of Messrs. Thomas J. Fleming and John A. Poillon.

THE AMERICAN INSTITUTE FAIR.—It is proposed to have at the next fair of the American Institute, which will be held at Madison Square Garden, from September 20 to November 4 next, a department of intercommunication. In this department will be exhibited everything pertaining to railways or any phase of transportation by land or water. It will include road vehicles, motor carriages, electric cars of all kinds, electric telegraphs, telephones, signals and alarms, etc., etc.

HEAVY HOLIDAY TRAFFIC ON THE BROOKLYN LINES.—On no two days in the history of the companies have the Nassau and Brooklyn Heights trolley lines in Brooklyn carried so many passengers as they did on Sunday and Monday, July 4 and 5. On Sunday the Nassau road carried 275,000 people, and on Monday 250,000. The Brooklyn Heights system received 325,000 fares on Monday, and 328,999 on Sunday, making a total of 1,178,999 persons carried by the two companies on the two days.

DAMAGED BY LIGHTNING.—The storm in this city and vicinity on the afternoon of July 2 did considerable damage to telegraph and telephone lines, and several electric light plants were crippled. At Canarsie lightning played pranks around the lighting plant, which was compelled to stop operations, leaving the town in darkness all the evening. The trolley service in Yonkers, N. Y., was disabled, the fuses in all the cars being burned out. Many accidents of slight character caused by the storm are recorded. The storm was a lively one for the short time during which it lasted.

GETTING READY FOR ELECTRICAL EQUIPMENT.—It is stated that part of the bonds issued by the Metropolitan Street Railway Company to raise the money for equipment with the underground trolley of the lines on which that system will be used, will be offered for public subscription next week. The issue is of $12,500,000, general mortgage, 5 per cent. fifty-year gold bonds, secured by a lien on all of the company's property. The whole issue has been underwritten by a syndicate and only about $2,500,000, it is stated, are yet unsold. The bonds will be offered at 105 and interest.

INJUNCTION DENIED.—Judge Beach, in the Appellate Division of the Supreme Court, on July 2, refused to issue an injunction restraining the Commissioner of Public Works from granting to the Metropolitan Street Railway Company, the lessee of the Eighth Avenue road, a permit to substitute electricity for horse power on the Eighth Avenue line. The action was brought two months ago by a taxpayer, Mr. Eugene C. Potter, to restrain Commissioner of Public Works Collis from permitting either the Eighth Avenue or the Metropolitan Railway Company from making excavations for an underground electrical conduit.

THE BROOKLYN CITY RAILROAD ASSESSMENT.—The assessment on the property of the Brooklyn City Railroad Company was made $4,032,350. To this the company protested, and the matter was taken to the Special Term of the Supreme Court, which decided against the assessors. Then the city appealed to the Appellate Division of the Supreme Court in Brooklyn, which court, on July 7, handed down a decision in favor of the defendant and sustaining the judgment of the lower court. Justice Cullen, in his opinion, states that it would be wise if there should be a rehearing before the assessors, on which they may probe the returns of the company to any further extent that they may desire and obtain any further evidence as to the assets of the corporation. But the assessment must be laid in accordance with the law, and the fact that the justice, or the favor of the statutes of the State, as construed by the courts, renders this relator subject to local taxation of some $5,000,000, and it exempts it from taxation on over $15,000,000, does not justify an attempt to value the latter class of property by a part of the former.

CONSOLIDATION TALK FROM BROOKLYN.—It is reported that plans are under way in Brooklyn looking to the consolidation of the Rapid Transit Company, which controls the Brooklyn Heights Railroad and the Queens County & Suburban Railroad, the Brooklyn City & Newtown Railroad, the Coney Island & Brooklyn road, and the Kings County Elevated Railroad. It is stated that Mr. D. O. Mills, who recently purchased a block of the Rapid Transit Company's stock, the Rockefellers and ex-Governor Flower have been the prime movers in the matter. In the plans proposed the Rapid Transit Company is to be the operating company, and the trolley system will be substituted for steam on the Kings County Elevated. It is expected that if the consolidation is consummated a saving of several hundred thousand dollars a year in operating expenses will result. It was intended at first to have the Nassau Electric Railroad and the Brooklyn Elevated road included in the consolidation, but it is understood the negotiations were broken off. Several New York financiers, including ex-Governor Flower, D. O. Mills, A. N. Brady, W. W. Huntington, Percival Kuhne and others on July 1 made a tour of inspection of the trolley system of the Brooklyn Heights Railroad Company. They were accompanied by the directors of the road. The trip was made in the palace car "Columbia."

AMERICAN GOODS IN SOUTH AMERICA.—The National Association of Manufacturers of the United States of America has just issued a circular of information regarding the proposed exhibition of American goods in the city of Caracas, Venezuela. Plans for the establishment of an exhibition warehouse in that city have been matured after months of careful investigation and study of conditions, and the association is now ready to receive applications for space in the building which has been secured for the purpose. The warehouse is designed to serve as a permanent exposition of American goods and as a headquarters for salesmen visiting Venezuela in the interests of exhibitors. The aim of the association in establishing this warehouse is to stimulate trade between the United States and Venezuela by familiarizing the merchants of Venezuela with American goods. The warehouse is being established under the terms of a special concession to the National Associaton of Manufacturers by the Government of Venezuela. This concession gives the privilege of entering goods free of duty when intended for exhibition in warehouses of the association in Venezuela, duty to be paid only in case of the actual sale of the goods. The enterprise seems to have been planned and undertaken on practical lines, and offers an extraordinary opportunity to open up and develop a market in Venezuela for American goods, which manufacturers should not be slow to take advantage of.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., July 5, 1897.

MR. E. L. BROWN has been elected assistant treasurer of the Bibber-White Co., Boston. Mr. Brown has been engaged in the banking business in Boston and naturally brings to his new position financial experience and ability. He appears to be possessed of the same active energy which is conspicuous in other officials of this progressive establishment.

EXTENDING THEIR FACILITIES.—Messrs. Whitman & Couch, Boston, Mass., United States selling agents for L. M. Ericsson's Swedish coal grain microphone and telephones, are extending their manufacturing and other facilities, thereby placing themselves in the best possible condition for quick work, not only in the prompt fulfillment of their present excellent business, but anticipatory, as well, of the increased business confidently expected as a result of a better public sentiment following the Detroit convention.

A LARGE CONTRACT AWARDED.—The Westinghouse Electric & Manufacturing Company has been awarded the electrical contract in connection with the Southern Union Railroad station, Boston, which, it is said, will amount to fully $500,000 or more. Messrs. Westinghouse, Church, Kerr & Co. are the engineers and contractors for this important installation. It is the intention of the managers of the new Union Depot not only to handle the largest number of trains entering any station in the world, but to handle them in the most complete and efficient manner. All the modern devices of interior motive power for heat, light, electric power, signalling, elevator work, refrigeration, ventilation, etc., will be taken advantage of in the equipment of this gigantic undertaking. In this fact lies the most important feature of the contract, because it was found by the management that it was necessary in order to obtain uniform work to put the entire matter into the charge of one firm, and as the Westinghouse interests as manufacturers of steam engines, electrical machinery and signalling apparatus were the only firm bidding for this work, and in a position to undertake it all, the management of the Terminal Company decided for that reason to entrust the Westinghouse Companies with the work.

WESTERN NEW YORK NOTES.

BUFFALO, N. Y., July 5, 1897.

CONSOLIDATION.—Friday last the Medina Gas & Electric Light Company consolidated with the Water Works Company under the name of the American Electric Light, Gas and Waterworks Corporation. The stockholders of the new organization are Rochester and New York mortgagees of the old plants.

TO GUARANTEE BONDS.—At a meeting of the stockholders of the Buffalo Street Railway Company on Tuesday last it was decided to guarantee the bonds of the Buffalo, Bellevue & Lancaster Electric Railway Company. This means that the Buffalo Company will practically assume control of the Lancaster road.

ELECTRIC LIGHT FRANCHISE GRANTED.—The Trustees of Hamburg have granted H. G. Pierce permission to operate an electric light system in the village. The system proposed will provide residences and stores with incandescent lights. The current will be generated at Water Valley, one mile from Hamburg.

THE DEPEW BOARD OF TRUSTEES has granted the Buffalo & Depew Railroad Company permission to construct a trolley road through the village. The company expects to have cars running by next spring at latest. It is said that it will take only about forty days to complete the construction of the road after the work is once started. Work will be begun as soon as an enabling certificate is granted by the State Railroad Commissioners.

FRANCHISES WILL PROBABLY BE GRANTED.—In the early part of last week the State Railroad Commissioners came to Buffalo to inspect the proposed route of the Buffalo, Hamburg & East Aurora electric road, whose promoters are petitioning the Commissioners for a franchise. Hearings were given on the question in Buffalo, East Aurora and Hamburg. The general sentiment is in favor of the road, and it is believed that the franchise will be granted.

ELECTRIC POWER IN TORONTO.—The Toronto Board of Aldermen has taken up the question of transmission of Niagara power to the Queen City of Canada. Replying to a communication from a member of the Board, Mr. L. B. Stillwell, electrical director of the Niagara Falls Power Company, wrote that while by January next he expects to have 10,000 horse-power going over the transmission lines to Buffalo, he is not yet prepared to give reliable information about the transmission of power such a great distance as to Toronto.

CAN'T SET POLES WITHOUT PERMISSION.—A test case of considerable importance was decided against the Bell Telephone Company at Medina last week. The company had set poles on the land of a farmer, Joshua Sharpsteen, without permission. Mr. Sharpsteen brought a suit for damages, and was awarded $44 by a referee. The case was taken to court, and the presiding judge confirmed the former verdict, and added to it the costs of the new action. It is said that already a number of similar actions have been begun against the company by Western New York farmers.

MORE NIAGARA POWER IN BUFFALO.—It is believed in this city that the $2,000,000 mortgage given by the Cataract Power & Conduit Company to the Metropolitan Trust Company, which is announced in another column in this issue, means the bringing of power and plenty of it to Buffalo. The wheel pit is now being extended to take in seven more dynamos, each with a capacity of 5000 horse-power. Vice-President Huntley, of the Cataract Company, said recently that the bonds are for the construction of lines and conduits for the distribution of Niagara power in this city. The main line will be brought up Niagara Street. Transforming stations will be built in different sections of the city, and every preparation will be made for the big demand for electric power that is expected next year.

PITTSBURG NOTES.

PITTSBURG, Pa., July 2, 1897.

ANOTHER TROLLEY ROAD FOR BEAVER COUNTY.—A charter was issued this week, at Harrisburg, to the Beaver & Vanport Electric Railway Company, for the construction and operation of a road two miles long, from Beaver to Vanport, in Beaver County. The company is capitalized at $12,000, and the directors are J. M. Buchanan, W. A. McConnell, J. H. Wilson, A. T. Anderson, all of Beaver, and J. T. Taylor, of Monaca.

NEW FACTORY FOR RÖNTGEN-RAY APPARATUS.—The Fessenden Manufacturing Company has taken out a building permit for a two-story frame building, to be erected on Beatty Street. The structure will be used for manufacturing Röntgen-ray machines and arc lamps designed and patented by Prof. Reginald A. Fessenden, of the Western University of Pennsylvania. The company at present manufactures these articles at its quarters in the Imperial Power Building, but deems it advisable to erect a factory for its own exclusive use.

CONSTRUCTION CONTRACT LET.—The recently chartered West End, Mount Washington & Banksville Traction Company, after securing from Councils an ordinance granting it the necessary franchises and rights of way, has just closed with James McSpadden a contract for the entire construction of its proposed lines. Work is to begin next week and according to the terms of the contract must be completed so that cars may be run not later than October 6. It is stated that passengers will be carried from the top of Mount Washington into the city for a single five-cent fare, and without transfer, and that the time required will not exceed twenty minutes,

Chicago Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., July 5, 1897.

SUDDEN CALL TO NEW YORK.—Mr. G. Condict, receiver for the Englewood & Chicago Street Railway Company, was suddenly called to New York last week on account of the illness of his daughter.

A VISITOR TO CHICAGO.—Mr. Charles Underwood Carpenter, of the Thresher Electric Company, Dayton, Ohio, made a pleasant call at the Chicago office of The Electrical World during the past week while passing through Chicago on a business trip.

MR. A. D. CHANDLER, for several years manager of the Chicago office of the American Circular Loom Company, has resigned his position and is no longer in the employ of the company. He is succeeded by Mr. Edward C. Brooks, who now has charge of the office, at 1114 Marquette Building.

ILLNESS OF MR. FERGUSON.—Mr. L. A. Ferguson, general superintendent of the Chicago Edison Company, is confined to his home with appendicitis. It is not thought, however, that an operation will be necessary. The many friends of Mr. Ferguson hope to see him soon restored to health.

FIRE.—The Duplex lamp-guard factory of Messrs. H. M. Underwood & Co. was destroyed by fire on Monday, June 28. The goods lost included 209 cases of lamp guards ready for shipment. This unfortunate occurrence will delay the delivery of the large number of orders on the firm's books two or three weeks.

NEW CHICAGO TELEPHONE OFFICIALS.—Mr. Robert T. Lincoln was elected president pro tem of the Chicago Telephone Company, on July 1, taking office with all the powers of president. The directors of the Central Union Telephone Company have elected Mr. W. A. Jackson president, to take effect July 1. Mr. Jackson was previously first vice-president and general manager of the company. His election and that of Mr. Lincoln fill the vacancies caused by the resignation of Mr. H. B. Stone, who was president of both companies.

St. Louis Notes.

St. Louis, Mo., July 5, 1897.

WANTS TO PUT UP POLES.—The Kinloch Telephone Company has applied for permits to the Board of Public Improvements, to erect poles outside of the conduit district. The public hearing on the permits has been set for July 13.

STREET RAILWAY LINE SOLD.—The Fourth Street & Arsenal Railroad was sold last Tuesday to Attorney Albert Arnstein for $70,050. He represents James Campbell, the broker, who it is generally understood represents John Scullin. Charles Green, the receiver, considered the amount obtained a fair price, and is fairly satisfied.

THE TELEPHONE COMPANIES GOING TO WAR.—At the called meeting of the stockholders of the Bell Telephone Company, it was announced that the increased capital stock recently certified to was needed because they wanted $600,000 for laying the underground conduit and $1,000,000 for the general extension of the business. A new equipment will be put in, including metallic circuit instruments and all the latest improvements. The Kinloch Telephone Company entering the field meant a strong opposition, in addition to the immense cost of laying the subways, and as the company had not accumulated a surplus, the only thing the Bell Telephone Company could do was to increase the capital stock. There is little doubt that there will be a telephone war. The Kinloch people have started in by reducing the rates now obtained by the Bell Company. They can do this because they learn they will have no royalties to pay to any other company. The Bell people will have to throw away their old equipment, which means a clear loss. The officials of the Bell Company refuse to state whether their plan includes a reduction in rates. They declare, however, that they will act when the Kinloch Company is ready for business. The officers of the Kinloch Company say they will still further reduce their rates if the Bell Company meet their cut. One of the directors says he would favor a cutting of rent down to $10 a year if necessary to get business.

Southern Notes.

Richmond, Va., July 5, 1897.

MUNICIPAL LIGHTING.—An election was held in Raleigh, N. C., on June 28, to decide the question of issuing bonds to erect and operate an electric light plant. The vote resulted in favor of the proposition, and it is expected that the commissioners will commence at once the building of the plant.

FRANCHISE REVOKED.—At the last meeting of the Richmond Council Committee on Streets, in an opinion by City Attorney Meredith, that official stated that as the city had revoked the franchise of the Bell Telephone Company, and the matter was in litigation, the city had no right to enforce the conduit ordinance, as far as it affects that company, until the matter was settled. As regards the other electrical companies, he is of the opinion that the ordinance can be enforced.

Pacific Coast Notes.

San Francisco, Cal., June 25, 1897

TO INSTALL AN ELECTRIC MINE PLANT.—The Overland Gold Mining Company, Charles S. Crysler, manager, Rockdale, Carbon County, Utah, will soon have an electric plant installed.

WATER-POWER ELECTRIC PLANTS.—The Big Creek Power Company of California now has two 500-hp units, consisting of Westinghouse generators coupled directly to Pelton water-wheels. The company has closed a contract to install a 60-light generator for H. F. Anderson, of Ben Lomond, to be operated by water-power of the San Lorenzo River.

WATER WHEEL FOR HONOLULU.—The Pelton Water Wheel Company, San Francisco, has just shipped to Honolulu, H. I., an impulse wheel which will be directly coupled, on the same base, with a Westinghouse generator that will furnish current to drive a large pumping plant at a plantation on one of the Hawaiian Islands.

ELECTRIC CONSOLIDATION IN UTAH.—It is reported that an electric power consolidation is about to be consummated in Utah. The companies that may be operated under a single management are: the Pioneer Electric Company, of Ogden and Salt Lake; the Ogden Gas & Electric Light Company, the Citizens Electric Light Company and the Big Cottonwood Power Company, of Salt Lake City, It is proposed to call the new corporation, to which the properties and franchises of the other companies would be transferred, the Consolidated Electric Light Company. The Pioneer Company has a pole line from Ogden to Salt Lake, which city it now holds a contract to light with 400 arc lamps at $6 per light—a cut of $2.50 under last year.

CONSOLIDATION OF ELECTRIC RAILWAYS IN OAKLAND.—It is currently reported that the Realty Syndicate has obtained control of additional street railway lines in Oakland, Cal. Mr. F. M. Smith, the borax king, Frank C. Havens, and others are prominent in the syndicate. The Oakland, San Leandro & Haywards electric road is about the only competing line remaining, excepting the Southern Pacific Railroad Company's cable line on San Pablo Avenue, and its electric line on Telegraph Avenue. The companies whose properties are to be transferred are the Oakland & Alameda Electric Railroad Company, the California Railway Company, which operates the road to Laundry Farm, and the California Improvement Company, which owns Leona Heights. The Realty Syndicate is said to now have control of electric railway lines in Oakland, Cal., as follows: From First and Franklin streets to Berkeley and the State University; from Fortieth and Grove Streets to Mountain View Cemetery; from Twelfth and Washington Streets to the Sixteenth Street station; from Thirteenth and Franklin Streets to West Oakland; from Eighth and Broadway to East Oakland; from Twelfth Avenue and Seventh Street to Fruitvale; the loop through Alameda and Oakland; from Park Street, Alameda, to Laundry Farm; from Santa Clara Avenue, Alameda, down San Jose Avenue; from Park Street through the eastern part of Alameda. This corporation also has an interest in the Mountain line, including the electric lines to Piedmont, to Mountain View Cemetery and from Seventh and Washington Streets to the Sixteenth Street station. It is stated that the syndicate will arrange to build a large central power station from which all of the consolidated street railway lines will be operated. Many persons think that the Southern Pacific Railroad Company is behind the deal, and wishes to control all of the railway traffic in Oakland.

English Notes.

(From Our Own Correspondent.)

London, June 23, 1897.

MUNICIPAL ELECTRIC LIGHTING AND ELECTRIC TRACTION SUPPLY.—A curious question threatens to arise at Glasgow. The Corporation of that enterprising Scotch city has for some time past municipalized its electric light supply and now proposes to apply electricity to its recently purchased tramway system. The municipal electric light supply urgently calls for extension, but the Electric Lighting Committee had postponed the detailed consideration of this question until the Tramway Committee had made up their mind whether or no they would adopt electricity for running the cars, never doubting for a moment that if electric traction were adopted the Electric Lighting Committee would be asked to supply the energy. It is stated, however, that the Tramway Committee have not seen their way to accept the offer of the Lighting Committee, and it is now an open question whether or no there will be a battle between the two committees of the Glasgow Town Council. The members of the Electric Lighting Committee question the legality of the proposed procedure of the Tramway Committee.

JUBILEE HONORS TO SCIENTISTS AND ENGINEERS.—It must be confessed that the extremely meagre list of jubilee honors connected with the names known to electrical science and engineering has caused considerable heart-burning in many quarters. If the age of Queen Victoria is notable for one thing more than another, it is that it has been an age of electricity, and yet there is not a single name of electrical note in the long list just published. It is true that Professor Crookes has received knighthood, but his work, great as it has been in the electrical field, has, of course, been much greater in the field of spectroscopy. Applied electricity, also, is scarcely less badly off. A baronetcy has been conferred upon Mr. James Pender, eldest son of Sir John Pender, whose name will ever be connected with the extension of submarine telegraphy, and a few obscure Indian telegraph officials have received stars and crosses, but none of the many men whose names are so honorably connected with electrical engineering have received any recognition whatsoever, not even the president of the Institution of Electrical Engineers or Mr. Preece, the chief engineer to the Post Office.

ELECTRIC LIGHTING SHARES.—I called attention in a recent letter to the great boom in electric lighting shares, those of the London companies having appreciated some 24 per cent. in market value in three months. That there is a real foundation for this sudden appreciation the recently published accounts of the four leading electric light undertakings in the metropolis amply show. During the year 1896 the capital expenditure of these four concerns increased by 14½ per cent., but as their electrical output also increased and by no less than 28½ per cent., they were able, notwithstanding considerable reductions in their tariff, to considerably improve their dividend-paying capacity. The foundation upon which the dividend-earning capacity of electric-lighting undertakings mainly rests is, of course, the relation of the capital expenditure to the electrical output, and it is interesting to observe that this vital figure has considerably improved. In 1895 the capital expenditure (in

shillings) per unit sold was in the case of the four leading companies in London 3s. while in 1896 this figure was reduced to 2s. 9d. The coal bill, upon which the engineer invariably fastens his eye, shows a similar reduction. In 1895 the cost of coal per unit sold was .68d.; in 1896 it was only .64d. It will thus be seen that there is a solid foundation for the operations of the "bulls" on the Stock Exchange.

ELECTRICITY AND THE JUBILEE ILLUMINATIONS.—Although information is not yet to hand with regard to the extra load imposed upon the central stations serving the City and West End districts of London, I should say from a casual inspection of a large proportion of the illuminations that it will not be found that the load was at all severe; indeed, I am more inclined to suspect that the evening load, owing to the absence of theatres, late shops, etc., etc., will be found to have been less on June 22, 1897, than it was on June 22, 1896. A tolerably large use of electricity was made, but it was nothing like so prominent as gas or the humble fairy-light, and in many cases it must be confessed it was nothing like so effective. One of the most artistic uses of it was when some stiff design of the monogram order was carried out by means of colored glow lamps, the whole being got up to resemble a framed picture. When it came, however, to outlining houses, etc., with glow lamps and also to lighting up the innumerable V. R.s, it must be admitted that the "shimmer" of the gas flames immensely added to the effect. Search lights were largely employed, and the dome of St. Paul's was lit by this means. On the whole, the most striking effect attained by electricity was in the illumination of the street decorations in the neighborhood of Pall Mall and St. James Street, where colored celluloid balls, strung across from mast to mast, were illuminated at night by means of glow lamps. The result was very fairy-like, and displayed considerably more originality than was evidenced by the general run of the designs. It would be difficult to imagine, until one had seen it, that any impressive effect could be produced by the simple placing of three or four red colored glow lamps on the window sills of a large building, but the tremendous size and height of the Grand, Metropole and Victoria Hotels rendered this simple device distinctly striking a little way off.

General News.

NEW INCORPORATIONS.

AUTOMATIC ELECTRIC TRACTION COMPANY, Chicago, Ill., has been formed with a capital stock of $30,000. Those interested are Zebulon Foster, Edward Foster and Stanton Foster.

THE PLYMOUTH TELEPHONE EXCHANGE, Sheboygan Falls, Wis., was organized, and the following officers were elected: President, George C. Huson; secretary, Dr. F. Derrwaldt; treasurer, George Corbett.

THE BARRINGTON ELECTRIC COMPANY, Barrington, Ill., has been incorporated with a capital stock of $10,000. The incorporators are Judson S. Joslyn, Albert F. Philbrick, Horace E. Shedd and Henry J. Brownell.

THE UNION PACIFIC RAILROAD COMPANY, Salt Lake City, Utah, has filed articles of incorporation with the Secretary of State. The directors are Edward Dickinson, Joseph H. Millard, J. A. Munroe and T. M. Orr.

THE PEMBROKE ELECTRIC RAILWAY COMPANY has been incorporated at the State Department, Harrisburg, Pa., with a capital stock of $300,000. The directors are Edward Thompson, Henry C. Ferry and E. D. Wadsworth.

THE TRI-CITY INTERURBAN ELECTRIC RAILWAY COMPANY, Ashland, Ohio, has been organized with a capital stock of $10,000, for the purpose of constructing an electric railway. The incorporators are Bert J. Hauk, C. A. Ulman and S. G. McCready.

THE UNION ELECTRIC CONSTRUCTION COMPANY, Des Moines, Iowa, has been formed with a capital stock of $5,000,000, for the purpose of engaging in all kinds of electrical construction work. The incorporators are W. B. Purvis, H. B. Feister and Henry Robinson.

THE GREENFIELD MUTUAL TELEPHONE COMPANY, Greenfield, Ohio, has been organized to do business in Greenfield and surrounding country. The Board of Directors are: Aaron Head, president; D. O. Miller, treasurer; Stanley Pike, secretary; C. E. Eckert, E. A. Squires, Dr. Edwin Waddell, Stewart Boden, O. E. Henry and Dr. E. J. Martin.

THE AMERICAN ELECTRICAL & MAINTENANCE COMPANY, New York City, N. Y., has been incorporated with a capital stock of $250,000. The incorporators are Henry A. Root, Arthur Hilton, Alfred K. Warren, George H. Cook, George Stanmore, James R. Steers, E. R. Johnes, William Duryea and Henry B. Wilson.

THE TELEGRAPH AND TELEPHONE.

ORWELL, OHIO.—A telephone line is being built between this place and Colebrook.

PORTSMOUTH, OHIO.—A new telephone line between this city and Lucasville will soon be ready for operation.

FRANKFORT, KY.—A telephone line between this place and Lawrenceburg is being rapidly constructed, and is about completed.

GALESBURG, ILL.—The Henderson County Telephone Company is making preparations to extend its line into Warren and Knox counties.

BELOIT, KAN.—There is every indication that the Beloit Telephone Company will make a start in the near future. Stock in the enterprise is being rapidly taken up.

MILLERSBURG, OHIO.—A telephone line between this place and Orrville has been completed. It connects with Apple Creek, Fredericksburg, Holmesville, Millersburg, Shreve and Wooster.

WINNEBAGO CITY, MINN.—The Blue Earth Valley Telephone Company has decided to extend its lines from Nashville to St. James and Madelia, and also from Wells south and west to various towns terminating the line at Blue Earth City.

LOUISVILLE, KY.—The Ohio Valley Telephone Company is preparing a new telephone equipment which will afford the people of Louisville a metropolitan service. The improvements are expected to be ready by the middle of July or the first of August. The expense of these changes will amount to more than $100,000. The exchange will be fitted up in the most modern manner.

NEW YORK, N. Y.—A dispatch from the City of Mexico states that the Postal Telegraph Company is stringing through Mexico two heavy copper wires, one from Laredo, Tex., and the other from El Paso, both ending at Mexico City. It is stated that the work of building these lines will be completed in about three months and that Postal offices will be established in all parts of the country.

ELECTRIC LIGHT AND POWER.

BOWLING GREEN, OHIO.—The electric light plant of W. H. Milliken was destroyed by fire on June 25. The loss is about $10,000.

CHAMBERSBURG, PA.—An election will be held in Shippensburg on July 27, to vote on the question of increasing the borough indebtedness $10,000 in order to provide an electric light plant.

FREMONT, OHIO.—The City Council, after several months' delay, has settled the electric light question by awarding a contract to the Fremont Electric Light Company, for two and one-half years, at $75 per light per year.

HARRISBURG, PA.—The Legislature finally passed, on June 28, the measure known as the Simons bill, which requires municipalities to purchase the franchises of electric light and gas companies before they can establish and operate plants of their own. The bill is now in the hands of the Governor for approval or disapproval.

NEWARK, N. J.—There is a report that several electric light companies doing business with municipalities in the northern section of New Jersey are to be consolidated. The purpose of the scheme, it is said, is to head off any future movement having for its object the municipal ownership of electric lighting plants. Among the companies mentioned in this connection are the Jersey City Electric Light Company, the Newark Electric Light & Power Company, the Suburban Electric Light Company of Elizabeth, the Morris County Electric Company, Morristown, N. J., and the Hudson County Electric Light Company. It is stated that efforts are being made to effect a consolidation of the Newark Gas Company and the Newark Electric Light & Power Company, with the ultimate intention of consolidating all the gas and electric companies in this section of the State.

THE ELECTRIC RAILWAY.

KEUKA, N. Y.—Surveyors are at work on the line of the proposed electric road from Savonna to Keuka, and work will begin as soon as the charter is obtained.

WILLIAMSPORT, PA.—A charter has been granted to the Montoursville Passenger Railway Company to operate by single or double track over the State road from Williamsport through Loyalsock township.

AUGUSTA, ME.—Articles of incorporation have been filed with the Railroad Commissioners for an electric railway beginning at Biddeford and running through Saco and Duxton to Bonny Eagle, in the town of Standish.

BURLINGTON, ILL.—A thunder storm a few days ago interrupted the trolley service and badly demoralized telephone, telegraph and electric light wires. Two thousand people were left stranded at Crapo Park Coliseum, a few miles from town, on account of the interruption to the railway traffic, and all were compelled to walk home in the darkness and mud.

MILWAUKEE, WIS.—The Milwaukee & Wauwatosa electric railway was sold at auction on June 26, the property being bid in by Mr. C. T. Rosenkrantz, for $43,500. It is supposed that the purchase is made for the street railway company, although this is denied in some quarters. The building and equipment of the line cost $306,000, and it is stated that the right of way alone is worth over a quarter of a million dollars.

CHICAGO, ILL.—Electric cars have taken the place of steam trains on part of the Suburban Railroad, which runs through the towns of Cicero, Riverside, Lagrange and other western suburbs. It is stated that within thirty days the steam locomotives will be entirely superseded and the electric cars will come into the business centre of Chicago over the Metropolitan Elevated Railroad tracks. This is the first steam railroad in and around Chicago which has been equipped with electric power for the propulsion of trains. The company is operating 22 miles of track by steam. Of this 2¼ miles will be operated jointly by steam and electricity. The balance of the 20 miles will be operated in a short time exclusively by electricity. The motor cars used on this road have double trucks and are 42 feet 6 inches over all in length. They are equipped with two 50-hp motors, air brakes and two trolley wires. They are vestibuled at each end, and each has a seating capacity of forty-eight passengers. The Suburban road at present, with its Chicago terminal in the Grand Central station, carries an average of 6000 passengers each week day, and the managers anticipate a large increase as soon as the cars come into the business centre over the Metropolitan Elevated road.

OBITUARY NOTES.

MR. HENRY B. STONE, who recently resigned the position of president of the Chicago Telephone Company and the Central Union Telephone Company, was killed on July 4, at his summer home at Nonquitt, Mass., by the explosion of fireworks. Mr. Stone was setting off fireworks for the amusement of his children and had lighted a bomb which failed to go off when the

light was applied. He took it up to see if the fuse was lighted, when the piece exploded, killing him instantly. Mr. Stone was forty-five years of age, and at one time held the position of general manager of the Chicago, Burlington & Quincy Railroad. It was Mr. Stone's intention to make a journey to Europe for a rest, and in order that he might get all the possible good out of his trip he had resigned his various positions in order to be free from the duties and cares connected with the same.

Trade and Industrial Notes.

REMOVING ITS FACTORY.—The Bossert Electrical Manufacturing Company, Utica, N. Y., is engaged in moving its machinery to its new quarters in the building erected on York Street for the company's own use.

DISSOLUTION OF PARTNERSHIP.—Mr. J. W. Hencke informs us that he is no longer connected with the Ohio Electrical Works, Cleveland, Ohio, as its treasurer, the partnership having been dissolved. Mr. A. C. Fletcher will conduct the business alone.

CAPTURING EUROPEAN TRADE.—The D. M. Steward Manufacturing Company, Chattanooga, Tenn., informs us that it is now busily engaged in filing orders from Europe. Its trade during June was unusually good. The company's lava insulators are growing in favor on account of their general serviceability. Insulators of all kinds are made by the company's patented process.

INCANDESCENT LAMP CATALOGUE.—The Beacon Lamp Company, New Brunswick, N. J., has just issued a catalogue of the various styles of lamps produced by this concern. Illustrations and specifications are given of standard, series, candle, bung-hole, candelabra, spherical, battery, sign, decorative, lantern, surgical, dental and lighthouse lamps, also Crookes tubes.

GAS ENGINE EXHIBIT.—At the Tennessee Centennial Exposition which is now being held at Nashville, the Otto Gas Engine Works, Philadelphia, have a large and interesting exhibit of gas engines. This includes seven different sizes, ranging from 3 to 45 horse-power, all in running order. This exhibit represents all the types of engines—stationary, marine and portable—built by the company.

THE UNIVERSAL A FAVORITE.—The Universal separable-step enamel rheostat, manufactured by the American Electric Heating Corporation, Boston, is rapidly increasing in favor and popularity. These rheostats are going into many of the important office and public buildings, including the New York and Boston Post Offices, also into several yachts. For marine work it fills a "long-felt want," and being of the most compact form possible they can be instantly repaired, whether in Japan, America or Alaska.

A GOOD SUMMER RESORT ELECTRICAL BUSINESS.—The Utica Electrical Manufacturing & Supply Company, Utica, N. Y., is doing considerable work at the summer resorts along the St. Lawrence River. It is putting in a lighting plant at the summer home of Mr. S. R. Van Duser, of Poughkeepsie, N. Y.; an annunciator system in the Thousand Islands Club House; wiring the Marsden House at Alexandria Bay; putting in a small lighting plant for the Thousand Islands House, and remodelling the lighting plant of the village of Alexandria Bay.

STORAGE BATTERIES ON THE PACIFIC COAST.—The Electric Storage Battery Company, Philadelphia, Pa., has just concluded a contract with the San Francisco Gas & Electric Company for a storage battery installation, having a capacity of approximately 8,000 lamps for three hours. This will be the first central station battery installed on the Pacific Coast. It is expected that this demonstration of the advantages of electric storage will lead to further installations, particularly in connection with water-power development, which is going on rapidly on the Pacific Coast.

WISCONSIN CONTRACTORS AND BUILDERS.—The Builders and Traders Exchange, Milwaukee, Wis., has issued a 278-page book giving a list of contractors and builders in the State of Wisconsin. Besides this list it gives all the State laws and the laws of the City of Milwaukee affecting buildings in every detail of construction. A business directory of Milwaukee City is also included in the work, and altogether the book will be of great value to builders and contractors, not alone in the State of Wisconsin, but in other States, who have dealings with firms in the Badger State.

FAN SEASON IN FULL BLAST.—The Hunter Fan & Motor Company, Fulton, N. Y., manufacturer of the Tuerk alternating-current ceiling fan, is operating its works far into the night, turning out fans to meet the demand, and should the orders continue to come in as they have, the company will be obliged to run both night and day shifts. These fans are rapidly coming to the front. Messrs. E. B. Latham & Co., New York, who are general selling agents for this fan, state that every day large orders are received for these goods, not only from domestic points, but also from South American republics.

A SATISFACTORY BUSINESS.—"Everybody is satisfied," remarked Mr. J. J. Gorman, president of the Manhattan Electrical Supply Company, New York, in referring to the large sales by that concern of Paragon fan motors. These fans are meeting with an unprecedented demand, and seem to have struck a popular vein. The company is "satisfied" in other ways, too. It is kept busy to meet the demand for its various specialties. The Mesco dry battery, for instance, hangs on in trade favor with a grim determination. The company's factory in Jersey City is running full time turning out telephones and supplies.

A GOOD TELEPHONE BUSINESS.—The Stromberg-Carlson Telephone Manufacturing Company, Chicago, is in a happy frame of mind, owing to the success with which its system is meeting. The company is doing a large business in its public and private exchange apparatus, and is receiving numerous calls for its police, fire and railway system, which is meeting with an extraordinary demand in foreign countries. The Stromberg-Carlson transmitter and receiver give, it is stated, such wide satisfaction that the success of the system is ascribed to this fact, and added to this are the completeness and durability of the apparatus. These telephones are being adopted for use in connection with the police and fire alarm systems in many of the large cities.

CINCINNATI ELECTRICAL CLUB.—The regular monthly meeting of the Cincinnati Electrical Club was held on Thursday, July 1, at the club rooms in the College Building. Mr. H. S. Rogers, division engineer of the General Electric Company, presented a very interesting paper on the "Monocycle System," in which he set forth in a very clear manner the various systems of alternating current transmission now in use, together with the advantages and disadvantages of each. The club decided not to hold the regular monthly meeting during August and September, but the club room will be open at all times to members.

THE ST. LAWRENCE POWER PLANT.—The contract for the turbines for the St. Lawrence Power Plant, which is to be built at Massena, N. Y., has been awarded to the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio. According to the terms of the contract this company will furnish fifteen units of 5250 horse-power each. The turbines will be mounted on horizontal shafts direct-conected with the electric generators, after the design made by Mr. John Bogart, engineer of the St. Lawrence Company, in consultation with the officers of the turbine company. Two turbines of the Victor type will be connected to each shaft, the aggregate horse-power of the two being 5250.

IMPROVING BUSINESS CONDITIONS.—There are kindred lines of industry which, although not called by the name electrical, certainly have a close connection. Among these might be mentioned the manufacture of automatic engines, which are used for electrical purposes. Prosperity or adversity is reflected from one to the other of these industries. When, therefore, we learn that large works like the Ball Engine Company, Erie, Pa., who build the high-grade Ball automatic engine exclusively for electrical purposes, are full of orders, we infer at the same time that the strictly electrical interests are improving. Among the recent contracts received by the concern is one from the Mount Vernon Company, Woodberry, Md., for a 100-hp Ball automatic engine. This is the second order for this make of engine.

A SIMPLE AND COMPACT SWITCH.—The F. & L. flush push-button switch is the Electric Appliance Company's latest specialty. This switch, which must be seen to be appreciated, is a very simple and compact device, the size of the face plate being no larger than an ordinary two-button gas key. The face plate is nickel plated, with pearl buttons. One of the merits of the switch is the ease with which it is operated. It is said to be a less expensive switch to make than any first-class push-button switch ever offered heretofore, and the Electric Appliance Company is thus enabled to offer it at even a lower price than the regular snap flush switch. It is at present made only in single-pole style, with a capacity of 5 amperes, although other sizes and capacities will be produced shortly. The F. & L. flush switch promises to find a large and useful field.

JUNE BUSINESS.—The heat of June does not seem to have taken any of the energy out of the Ridgway Dynamo & Engine Company, Ridgway, Pa., judging from the contracts it made in June. Among them we note the following: One tandem-compound engine, for Purdue University; one 150-kw plant for Northwestern Mining & Exchange Company; two 75-kw direct-current plants for the University of Michigan; two 50-kw generators for the city of Buffalo, N. Y.; two 75-kw generators, direct-current, to tandem-compound engines for the Tulane Hotel, Nashville, Tenn.; and one 10-kw plant for W. H. Brown & Son, Pittsburg, Pa. The equipment of the University of Michigan will be on the Arnold system, so that either generator may be run by either engine. Twenty-three other concerns figured on this plant, and the Ridgway Company naturally feels happy over its success in capturing it.

COMBINATION WATER MOTOR AND DYNAMO.—The Carlisle & Finch Company, Cincinnati, Ohio, has recently placed on the market a small combination water motor and dynamo to be used for experimental work, for charging storage batteries, etc. It can be attached to any hydrant or faucet by means of the rubber hose furnished, and with 40 to 100 pounds water pressure it will develop 1 to 2 amperes at a pressure of 8 to 10 volts. There is a great demand for this convenient little generator among the bicycle fraternity, who find in it a most desirable method of charging the storage batteries used with their electric headlights. A great many of these dynamos are used by doctors in charging the storage batteries for their medical and cautery apparatus. The amount of water used being small there is no charge for same, thus rendering it possible to obtain electric current at practically no expense whatever for power. This company reports an immense sale of this novelty.

FACTS ABOUT ALUMINUM.—The Pittsburg Reduction Company, Pittsburg, Pa., has just isssued a catalogue on aluminum that is probably the most complete work on the subject that has ever been published. Every known fact concerning this interesting metal is given in detail, and the various alloys of aluminum with other metals, methods of working the metal, etc., will be of value and interest to engineers. The information regarding aluminum is given in every possible form, and its physical relations with other metals are presented in a manner that will be extremely valuable to those concerned in the use of this metal. Beside the matter concerning aluminum, the book contains a vast amount of engineering information and tables which are calculated to aid the engineer in his work. The table of contents which is given at the beginning of the book presents an epitome of the work, and the index at the back is most complete, and will enable anyone searching for information to refer with the greatest ease and promptness to the subject he is looking for. The book is gotten up in a very careful and substantial manner ,and will no doubt find an important place in the libraries of engineers, to whom it certainly will be a very useful work.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 29, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

585,171. BURGLAR ALARM SYSTEM; W. T. Arnold, Chicago, Ill. App. filed December 15, 1896. In a burglar alarm system, the combination of a sliding cover adapted to be placed over an opening or object, and having a mounting or support which permits of its ready closing or changing device adapted to be operated by said cover when the cover is shifted from its normal plane, a burglar alarm circuit including a signal or alarm apparatus adapted to be actuated by the burglar alarm circuit when altered by operation of said circuit closing or changing device.

585,185. EARTH CONDUCTOR OR GROUND WIRE ATTACHMENT; H. M. Crane, Boston, Mass. App. filed May 10, 1897. A connector for attaching a ground-wire, or an electric circuit or protector earth conductor, to a gas or water-pipe, consisting of a metal angle-piece having slots, and a threaded perforation through one of its faces; a metal strip secured at one end to the outside of the perforated face, arranged to pass twice in opposite directions through the first slot, and once through the other, and adapted to surround the said grounding-pipe between the points passing the said first slot; and a tightening set-screw associated with the threaded perforation of the said angle-piece, and impinging upon the metal strip between its fixed end and the nearest slot thereto.

585,229. APPARATUS FOR APPLYING HEAT TO THERMO BATTERIES; H. C. Reagan, Jr., Philadelphia, Pa. App. filed May 15, 1896. The combination with a locomotive boiler, carrying a pumping device and having a stack and smoke-box, a thermo-battery surrounding said smoke-box, a water-jacket surrounding said battery, a connection intermediate said pumping device and water-jacket and an overflow or outlet for the latter.

585,249. ELECTRIC CLOCK; R. Baumann & T. H. Wurmb, St. Louis, Mo. App. filed May 18, 1896. A side-pull rocking armature mounted upon the shaft of the clock, an arm projecting at right angles from the centre of said armature, a bell-crank lever pivotally mounted upon one of the posts of said clock, a pin attached to one end of said bell-crank lever and engaging a bevel face upon the free end of said arm, a lug in position parallel with said pin, a toothed wheel mounted upon the shaft of said clock and in position to be engaged by said lug, a lug upon the opposite end of said bell-crank lever from the other lug and in position to engage the teeth of a wheel.

585,250. COMBINED ELECTRIC FAN AND ELECTROLIER; E. H. Bennett, Jr., Bayonne, N. J. App. filed June 14, 1893. The combination with an electric fan and a central support for said fan and its motor, of an electrolier also sustained by said central support and comprising a plurality of series of electric lamps which are carried by a holder detachably connected with said central support so that the lamps carried thereby may be removed from the fan, collectively, by detaching said holder.

585,255. CONTACT BOX FOR ELECTRIC RAILWAYS; W. M. Brown, Johnstown, Pa. App. filed July 18, 1896. In a contact box a sealed vessel removably secured within said box, contaning a switching mechanism consisting of a solid conductor floating or immersed in a liquid conductor.

585,257. ELECTRIC METER; F. P. Cox, Lynn, Mass. App. filed March 6, 1897. The combination of a meter for registering at different rates at different times, consisting of a single motor mechanism and single registering mechanism, and means for controlling the speed of the motor for a given load from a point distant from the meter, as, for example, from a station or a substation.

585,258. ELECTRIC METERING APPARATUS; F. P. Cox, Lynn, Mass. App. filed March 6, 1897. An electric metering apparatus comprising a number of recording devices giving independent readings, one of said devices arranged to operate and continuously record all the electrical energy consumed, and means for periodically throwing the other measuring device out of and into operation at predetermined times.

585,267. ELECTRIC TROLLEY DEVICE; A. J. Gairing, Johnstown, Pa. App. filed Dec. 26, 1896. In an electric trolley device, the combination of a base, transverse pins secured thereto in the same horizontal and transverse planes, a plurality of converging arms pivoted near their lower end about each of said pins and constituting sides of a lazy-tongs, pivotal connections at the upper ends of the arm with the upper sides of the lazy-tongs, and spring devices connected to the lower sides below their pivotal points.

585,287. GROUND DETECTOR; E. W. Rice, Jr., Schenectady, N. Y. App. filed March 1, 1897. In an electrostatic device the combination of a system of stationary inducing plates, some of which are connected to one side of the line and others to the other side, a second set of plates maintained at equal potential and insulated from the first, and an indicating device in inductive relation to the stationary plates.

585,293. ELECTRIC CONTACT DEVICE; S. H. Stahl, Johnstown, Pa. App. filed Feb. 23, 1897. In an electric contact device a contact carrying frame composed of jointed links, the joints being located alternately on opposite sides of the vertical longitudinal centre of the device.

585,301. ELECTRIC TOWER CLOCK; T. H. Wurmb & R. Baumann, St. Louis, Mo. App. filed May 18, 1896. In an electric clock and switch connected to and operated by rocking armatures, which switch consists of a lever pivoted at one end, a bar connected to the rocking armatures and operating transversely of the free end of said lever, a pin fixed in the end of said bar and operating in the slot in the free end of said lever, a lug attached to the free end of said lever, a pin transversely fixed to said lug, contact-points upon the opposite ends of said pins, springs fixed to the base of the machine by posts, the free ends of said springs being positioned adjacent to said contact-points, set screws for adjusting the free ends of said springs and suitable electrical connections.

585,307. ELECTRIC DYNAMO OR MOTOR; C. E. Emery, Brooklyn, N. Y. App. filed April 20, 1893. An electric dynamo or motor, without field-coils, provided with an armature, a commutator, commutating brushes, a permeable yoke and pole-pieces attached thereto, with the width and length of the faces of such pole-pieces so proportioned and the angle of commutation so adjusted by shifting the brushes that the required number of turns of the armature (counted on one side) will be included in the double angle of commutation to produce, with the current flowing in the armature, the desired number of ampere-turns of exciting force to produce the field.

585,308. ELECTRIC BROILER; G. B. Fraley, Denver, Col. App. filed Oct. 28, 1896. In an electric broiler supporting devices for the meats or other articles to be broiled, heating-blocks located on either side of said devices and independent therefrom, means for passing an electric current through said heating-blocks, and means for rotating the latter and said supporting devices in unison without interrupting the flow of electricity to said blocks.

585,309. ELECTRIC HEATER; G. B. Fraley, Denver, Col. App. filed Oct. 28, 1896. In an electric heater, a block having a substantially upright channel therein, independent elements of conductive material located in said channel, means for causing said elements to contact with each other throughout the operation of the heater, and means for supplying electricity to said elements.

585,310. ALTERNATING CURRENT ELECTRIC HEATER; G. B. Fraley, Philadelphia, Pa. App. filed April 27, 1897. In an electric heater, the combination of a tubular core formed of a convoluted sheet of conducting material having its ends electrically connected and constituting a closed circuit secondary coil, insulation between the convolutions of the sheet, a primary coil surrounding and in inductive relation to the secondary coil and insulated therefrom, and means for putting the primary coil in circuit with a source of alternating current.

585,311. ELECTRIC HEATER; G. B. Fraley and A. B. Paulson, Philadelphia, Pa. App. filed Sept. 21, 1896. In an electric heater the combination of a slotted core and a resistance-coil wound around the said core.

585,316. ELECTRIC ARC LAMP; P. H. Klein, Jr., New York, N. Y. App. filed March 20, 1897. In combination with the supporting frame of an electric lamp, and a globe for said lamp, which globe has a portion with reduced diamater toward that extremity by which it is to be attached to the lamp-frame, of a two-part thimble located within said globe, provided with means of attachment to the lamp-frame, and with enlargement ends which, when the said parts of the thimble are assembled in position, bear against the inner side of that portion of the globe reduced in diameter, and against the outer end respectively.

585,317. ELECTRIC ARC LAMP; P. H. Klein, Jr., New York, N. Y., and E. Lavens, Brooklyn, N, Y. App. filed Nov. 9, 1896. A support for the globe, a hanging rod bearing such support and lugs at the upper end of such hanging rod, in combination with a supporting-bracket having cuts and seats to receive said lugs on the hanging rod, said seats being higher on one side than on the other, and a stop-pin on said hanging rod so placed as to prevent said lugs being lifted over the higher sides of said seats.

585,318. ELECTRIC ARC LAMP; E. Lavens, Brooklyn, N. Y. App. filed March 20, 1897. In an inclosed electric arc lamp, the combination of the lower-carbon holder which has a vertically-bored out portion for reception of the carbon, the sliding pivoted cover for the lower end of said carbon-holder, and means for pressing said sliding cover against the bottom of the carbon-holder to secure an air-tight covering therefor.

585,319. TELAUTOGRAPH; L. O. McPherson, Highland Park, Ill. App. filed Nov. 24, 1896. The combination of a line wire, means for causing pulsations to traverse the same, and a governor operating to change the strength of current on line to compensate the effects of changes in frequency of the pulsations.

585,321. INSULATING JOINT; L. F. Van De Wiele, Brooklyn, N. Y. App. filed Oct. 14, 1896. An improved insulating joint, having a yoke, two insulating-discs fitting upon each other, a hickey which fits between said discs and is insulated by them from the binding-pin and the yoke, and a binding-pin which carries the insulating-discs in the yoke.

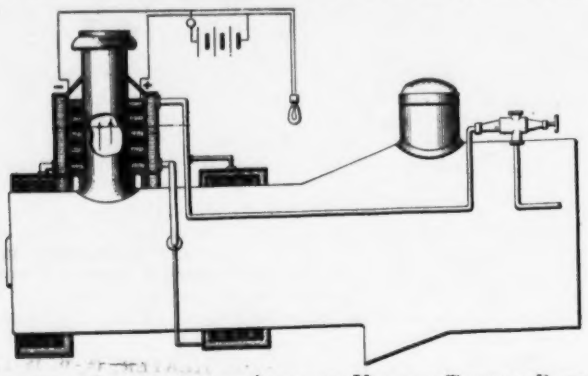
585,342. ELECTRIC TRAIN-SIGNAL; M. W. Parrish, Detroit, Mich. App. filed Nov. 7, 1896. A signaling system comprising the two circuits, a signal, a source of electric energy, spool magnets, a pivoted muffling-armature, and a permanent magnet adapted to lock the muffling-armature when the signal-circuit is broken.

585,350. BRACKET FOR INCANDESCENT LAMPS; H. Noreck, Charlottesville, Va. App. filed March 5, 1897. A bracket for incandescent lamps consisting of a tubular section through which the wires extend, said section having an exterior screw-threaded neck, and an overlapping guard surrounding said neck and forming a space between the two, and the section to form a hood to receive the socket of the lamp, said section having an interior screw-threaded neck which fits the space between the exterior screw-threaded neck and the guard, and engaging with the threads of the former,

585,359. PROCESS OF OBTAINING POROUS METALS BY ELECTROLYSIS; L. Hopfner, Berlin, Germany. App. filed Oct. 5, 1896. An electrolytic process of obtaining composite metal plates which consists in electrically precipitating a porous or spongy metal, and stiffening the same by precipitating thereupon a denser metal.

585,379. DYNAMO-ELECTRIC MACHINE; G. E. Dorman, Chicago, Ill. App. filed Feb. 4, 1896. The combination in a dynamo-electric machine of an armature provided with a series of poles having coils thereon, a series of field-magnet poles arranged around the armature, one end of the coils of the armature being connected together, the other end of each coil being connected to a section of a commutator, and a conducting device associated with said commutator and the connected ends of said armature-coils, said conducting device arranged so as to short-circuit one or more of said armature-coils at a predetermined point.

585,380. TROLLEY GUARD; W. C. Dunham, Indianapolis, Ind. App. filed Dec. 27, 1895. The combination in a trolley structure, of the trolley-arm, a trolley-arm head thereon, the trolley-wheel, an automatically-acting wire catching and restoring device provided with fingers and located alongside said wheel with its catching-face normally below the groove in said trolley-



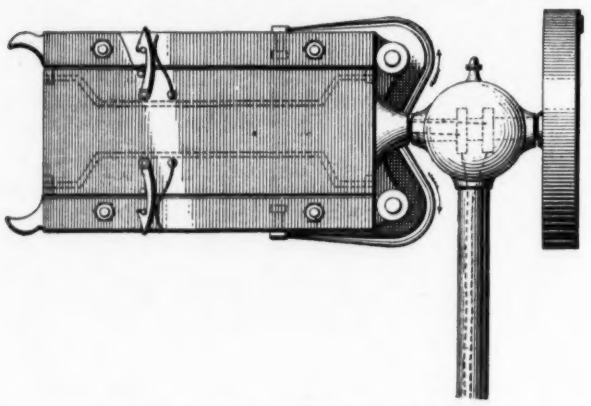
No. 585,229.—Apparatus for Applying Heat to Thermo Batteries.

wheel, and arranged to rise above said groove by force imparted from contact with the wire after catching it.

585,444. RHEOSTAT AND CIRCUIT CONTROLLER; H. W. Leonard, East Orange, N. J. App. filed Nov. 24, 1896. The combination in an automatic circuit-controller, of an electro-responsive device connected across the terminals of a translating device so as to be subjected to the same E. M. F. as the translating device, a circuit-controller held by said device in a definite position under normal conditions and which device releases said controller when the E. M. F. at the terminals of the translating device is abnormally low, means for effecting the release of said controller when the current through the translating device is abnormally large, and means for operating said controller when so released to prevent or reduce the flow of current through the translating device.

585,472. SECONDARY BATTERY; G. E. Hatch, Quincy, Mass. App. filed April 28, 1896. The mode of preparing a secondary battery element, said mode consisting in autogenously forming a porous layer of active material from the metal of the electrode by electrolytic action, then loosely confining against the porous layer thus produced active material or material to become active, in a granular or pulverulent condition, and continuing the electrolytic action so as to effect the union of this loosely-confined mass with the autogenously-produced porous layer on the plate.

585,473. SECONDARY BATTERY; G. E. Hatch, Quincy, Mass. App. filed April 28, 1896. A secondary battery consisting of one or more pairs of supports, the inner faces of which are provided with pockets to which



No. 585,308.—Electric Broiler.

the active material is applied and by which it is sustained in contact with the interposed conducting electrode, each of said supports being composed of a number of plates of stiff porous earthenware disposed edge to edge, bearing surfaces being formed between the separate plates of greater width than the average thickness of the plate.

585,507. CIRCUIT BREAKER FOR ELECTRIC WIRES; A. J. Clark, Lexington, Ky. App. filed Nov. 21, 1896. A circuit breaker for a suspended electric wire, comprising vertical levers, each having a contact-plate extending from its lower end and at right angles to the levers, and a block of insulating material to which the upper ends of the levers are pivoted, the longitudinal axis of the pivot being arranged at an obtuse angle transversely to the contact-plates.

585,511. CIRCUIT CONTROLLER FOR ELECTRIC MOTORS; H. H. Cutler, Chicago, Ill. App. filed Jan. 3, 1897. The combination with a circuit-controlling arm or element, of a retaining electromagnet for locking the same in position, means for moving the same when released to alter the condition of the circuit, a releasing-electromagnet for de-energizing said retaining electromagnet upon the flow of an abnormal current, and means for adjusting said releasing electromagnet to cause the same to respond to a predetermined current strength.

585,512. CIRCUIT CONTROLLER FOR ELECTRIC MOTORS; H. H. Cutler, Chicago, Ill. App. filed Jan. 8, 1897. The combination with a circuit-controlling arm or element, of a retaining electromagnet for locking the same in position and provided with opposed windings, means for moving said element when released to change the condition of the circuit, and a releasing-electromagnet for normally maintaining one of said windings of said retaining electromagnet out of operative condition.

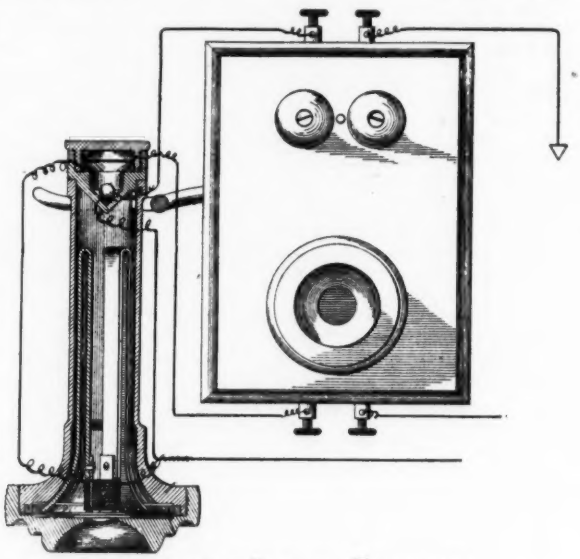
585,527. ELECTRIC MOTOR; C. Lindberg, Duluth, Minn. App. filed Feb. 24, 1896. In an electric motor or dynamo, the combination with a frame provided with field magnets, of an armature within said frame comprising a core provided with grooves in its periphery and independently removable magnets arranged about the same, each of said magnets consisting of three approximately vertical webs connected by an approximately horizontal web so as to form a double diverging spool, one of said vertical webs being deeper than the others for engaging the said grooves in the armature, to assist in holding said magnets in proper place.

585,560. ELECTRIC TELEPHONE, C. F. Dunderdale, Chicago, Ill. App. filed Jan. 7, 1895. In a telephone receiver a gravity switch therefor, consisting of a chamber divided into two compartments, located in the interior end of the receiver, a movable-ball contact-maker normally resting within one compartment of the chamber when the receiver is not in use, leads of the signaling-circuit terminating in said compartment, whereby the said circuit is normally completed by said movable-ball contact and leads of the talking-circuit terminating in the other compartments of said chamber, whereby when the receiver is tilted in use the movable ball contact from one compartment into the other, thereby disestablishing the signaling circuit and establishing the talking circuit.

585,579. TROLLEY FOR ELECTRIC CARS; J. C. Kellogg, Lexington, Ky. App. filed Sept. 25, 1896. The combination with a harp and trolley-wheel and axle, of arms pivotally connected intermediate their ends to said axle, a flaring fork at the upper ends of said arms, the ball or yoke pivotally connected with the lower ends of said arms and spring arms secured to the fork and bearing against said wheel.

585,602. TROLLEY FOR ELECTRIC RAILWAYS; V. Thelin, Geneva, Switzerland. App. filed Nov. 30, 1896. Two arms pivoted at their lower ends, a pulley with its centre in line with the pivots, a spring and connections extending therefrom to opposite sides of the pulley, so that the one spring acts to swing the arms vertical, in combination with a bow, a transverse bar on which the bow is pivotally connected to the upper ends of the arms, and springs acting upon the bow to raise the outer portion into contact with the trolley-wire and by which the parts are caused to turn automatically into their correct position when the direction of motion of the car is reversed.

585,603. ELECTRIC ARC LAMP; C. J. Toerring, Jr., Washington, Pa. App. filed Jan. 2, 1896. In an electric arc lamp, the combination with an arc-inclosing globe, a mounting for the same permitting lateral movement of



No. 585,560.—Electric Telephone.

the upper end of the globe, and a cover having a hole for the passage of the upper carbon.

585,620. ELECTRIC ACCUMULATOR SYSTEM; H. B. Cox, Hartford, Conn. App. filed Nov. 7, 1896. In an electric accumulator system, the combination of two concentric rings of insulated contacts forming pairs of opposite contacts, sets of accumulators, direct electric connections between the contacts of one ring and said sets of accumulators, direct electric connections between each contact of a pair with the electrically-opposite contact of an adjoining pair, an insulated member concentrically within the rings and provided with two insulated brushes sliding in electrical engagement with the inner edges of the contacts of the two rings, respectively, a source of electrical energy of which said brushes form the opposte terminals and driving means shifting the electrical contact between the brushes and each pair of contacts at regular intervals, so that the current of the generator is concentrated on each set of accumulators in regular succession.